3.22 HUMAN HEALTH

This section describes current human health conditions and evaluates potential project impacts on human health with in the EIS Analysis Area from the proposed action and alternatives. Human health data for the EIS Analysis Area are generally available at broad scales, rather than at a community level. Where differences are able to be distinguished at a component level, these are discussed. However, as with socioeconomic data, the project is more typically evaluated by phase for the project as a whole. Impacts were evaluated using Alaska Department of Health and Social Services (ADHSS) methodology (ADHSS 2011, 2015); impact terminology and ratings differ from other sections in the EIS.

For the purposes of this document, health is defined by ADHSS not merely as the absence of disease, but as “the reduction in mortality, morbidity, and disability due to detectable disease or disorder, and an increase in the perceived level of health” (ADHSS 2011). Thus, it represents an integrated state of physical, social, and mental well-being. Health is affected by environmental, social, cultural, and genetic factors often called “determinants of health.” Community health in Alaska, with its environmental and social setting and complex blend of health determinants, is in many ways different from national health trends in the United States (ADHSS 2011).

Large projects such as mining activities can often affect the health of nearby communities in complex ways. The impacts may be both positive and negative. The Donlin Gold Project is a large and complex mining project which is expected to affect the socioeconomic and health aspects of a very large area (see Chapter 2, Alternatives, for project description). The health assessment for this project is intended to document baseline health status in the EIS Analysis Area so that project-related negative health consequences may be avoided or reduced and health benefits optimized.

The ADHSS contracted the collection of baseline health data (NewFields 2013) for the eventual development of a Health Impact Assessment (HIA). The HIA is still under development, but the available baseline health data were used to develop the description of the affected environment. For the purposes of this EIS, the baseline information was categorized within the context of the three project components (mine site, transportation facilities, and pipeline) and with a functional classification of potentially affected communities as mine site, river, and pipeline-related communities. The baseline information has been condensed and summarized for this EIS. Where available, additional data have also been incorporated from publicly-available sources (e.g., mercury data from hair samples collected by ADHSS).

SYNOPSIS

Summary of Existing Conditions:

The EIS Analysis Area for human health includes communities within the Bethel Census Area, Yukon Kuskokwim Health Corporation (YKHC) Service Area, eight central Kuskokwim River communities near the mine site, Tyonek, and Dutch Harbor. Much of the region is classified as medically underserved or has a shortage of health care professionals; the more urbanized communities are serviced by a more extensive network of healthcare facilities. The Y-K region typically fares worse than the state average in aspects of physical, mental, and social health. Examples of this include high rates of suicide, sexually transmitted infections, and poor access to water and sanitation services. Important health strengths include high rates of childhood immunizations in the YKHC service area, no clear signs of nutritional deficiencies in the Bethel Census Area, and residents report leisure time participation in physical activities. Rates of low birth weight infants and alcohol use by pregnant mothers and divorce rates were lower than state averages.

Expected Effects:

Alternative 1: No Action – This alternative would have low direct or indirect effects to human health, largely returning to pre-impact levels of health. Current health conditions and trends would continue in the EIS Analysis Area.

Alternative 2: Donlin Gold's Proposed Action – Impacts to human health would be both beneficial and adverse (positive and negative). Impacts would generally be considered medium in magnitude or intensity. The duration of the impacts would generally be considered very high and the duration would be medium to high in geographic extent. Overall effects would be considered medium. Eight Health Effects Categories (HECs) provide a framework for discussion of potential impacts.

Social Determinants of Health: Medium beneficial effects could include increases in household income, employment and educational attainment and reductions in psychosocial stress. Medium adverse effects could include increases in psychosocial stress, substance abuse rates, and family stress and instability.

Accidents and Injuries: Medium level adverse effects could include the potential for accidents and unintentional injury.

Exposure to Potentially Hazardous Materials: Adverse impacts from exposure to potentially hazardous materials are generally considered low.

Food, Nutrition, and Subsistence Activity: Potential medium to high level health benefits would be due to decreased regional food costs and increased food security (resulting from potential increases in median household incomes). Low level adverse impacts could include a potential for decreased access to and/or quantity of subsistence resources.

Infectious Diseases: Adverse impacts due to increased rates of infectious diseases are rated low to medium. Increases in infectious disease rates could occur due to employment of workers from outside the region and/or the rotation of the workforce during the project phases.

Water and Sanitation: Adverse effects due to the availability and quality of water and sanitation facilities are considered low; it is unlikely that water and sanitation services of communities located near the proposed project would be affected.

Non-communicable and chronic diseases: Increased rates of cancer, respiratory disease, and cardiovascular morbidity and mortality are considered unlikely (10-33 percent), with a summary impact rating of medium.

Health Services Infrastructure and Capacity: Under routine conditions, decreased access to healthcare services would be low. Under emergency situations, the potential to overwhelm regional health care capacities would be considered high; the event is considered very unlikely (1-10 percent), with a summary impact rating of medium.

Other Alternatives: The effects on human health from Alternative 5A and 6A would be very similar to the effects of Alternative 2. Differences of note for other action alternatives include:

- *Alternative 3A (LNG-Powered Haul Trucks)* would decrease the total number of barge trips per season by 33 percent, resulting in a decreased potential for accidents and reduced impacts to fish resources and subsistence fishing. Additionally, the reduced diesel emissions would reduce exposure to hazardous constituents in the air, water, and aquatic biota at the mine site and along the transportation corridor. These are considered to slightly reduce health impacts, compared to Alternative 2.
- *Alternative 3B (Diesel Pipeline)* would decrease the annual barging by 48 percent, resulting in a decreased potential for accidents and reduced impacts to subsistence fishing. There would be fewer impacts to air quality, water quality, and biota along the Kuskokwim River, associated with the decrease in barging. These are considered to slightly reduce health impacts, compared to Alternative 2.
- *Alternative 4 (Birch Tree Crossing [BTC] Port)* would increase the mine access road by 46 miles, resulting in an increased potential for surface transport accidents. The additional surface transport has the potential for increased displacement of terrestrial subsistence resources. The shortened round trip barge trip would result in reduced potential for impact to subsistence fisheries, especially for the upriver communities. These are considered to slightly reduce health impacts, compared to Alternative 2.

3.22.1 REGULATORY ENVIRONMENT

The primary guidance used for this assessment is the *Technical Guidance for Health Impact Assessment (HIA) in Alaska*. July 2011 V1.0, published by the Alaska Department of Health and Social Services (ADHSS). This document uses the principles of HIA guidance developed by the International Finance Corporation (IFC 2009) to provide a comprehensive framework and tools for addressing health in a manner that is relevant to Alaskan conditions and was developed in consultation with local and regional agencies, and community stakeholders. As described by ADHSS (2011), "HIA is a structured planning and decision-making process for analyzing the potential positive and negative impacts of programs, projects, and policies on public health."

The preparation of this HIA is consistent with ADHSS (2011) and other guidelines that include the following:

- Screening: The initial phase where the need for a HIA is evaluated. The Donlin Gold EIS will include an HIA.

- Scoping: The phase that develops the scope of the HIA and key issues to be addressed based on consideration of project description, surrounding environment, stakeholder concerns, and other factors. Personnel from ADHSS, their contractor, and Yukon-Kuskokwim Health Corporation (YKHC) held meetings with community stakeholders to identify issues of health concern to be addressed in the EIS (NewFields 2015). ADHSS staff also attended the EIS scoping meetings to document comments and concerns related to health.
- Health Risk/Impact Assessment: The phase that includes the Community Health Baseline and Risk / Impact Assessment.

ADHSS (2011) identifies eight Health Effects Categories (HECs) which are particularly relevant to Alaskan conditions to be included in this assessment. A HEC contains a routine set of health issues and concerns that are commonly grouped together, such as accidents and injuries. Past HIA experience in Alaska has demonstrated that the HEC framework is useful for analyzing, rating, and ranking potential impacts, both positive and negative. Table 3.22-1 summarizes these HECs and health impact issues within each of the HECs. The health impact issues presented are those that may be particularly relevant to the proposed project:

Table 3.22-1: Health Effects Categories (HECs) and Health Impact Issues

Category	Health Impact Issues	Summary Table Numbers
HEC 1. Social determinants of health	· Household incomes, employment and education · Psychosocial stress · Substance abuse (including drug and alcohol) · Family stress/stability	Table 3.22-4
HEC 2. Accidents and injuries	· Unintentional accidents and injuries morbidity and mortality rates due to air transportation · Unintentional accidents and injuries morbidity and mortality rates due to surface transportation · Unintentional accident and injury morbidity and mortality rates due to water transport · Intentional injury: suicide rate	Table 3.22-5 Table 3.22-5.
HEC 3. Exposure to potentially hazardous materials	· Air quality (mercury, PM, and VOCs) · Surface water quality · Groundwater quality · Soil quality · Bioaccumulation of chemicals into fish · Bioaccumulation of chemicals into waterfowl and wildlife	Table 3.22-6 Table 3.22-7
HEC 4. Food, nutrition, and subsistence activity	· Region food costs (expressed as a percent of median household income) · Access to and quantity of subsistence resources · Diet composition and food security	Table 3.22-8

Table 3.22-1: Health Effects Categories (HECs) and Health Impact Issues

Category	Health Impact Issues	Summary Table Numbers
HEC 5. Infectious diseases	· Sexually-transmitted infection rates (including gonorrhea, chlamydia, Hepatitis C, and HIV) · Infectious (respiratory) disease morbidity and mortality rates (e.g. influenza and pneumonia) · Rates of foodborne illness and zoonotic diseases	Table 3.22-9
HEC 6. Water and sanitation	· Morbidity and mortality rates due to the availability and quality of water and sanitation facilities	None
HEC 7. Non-communicable and chronic diseases	· Cancer morbidity and mortality rates · Respiratory morbidity and mortality rates · Cardiovascular morbidity and mortality rates	Table 3.22-10
HEC 8. Health services infrastructure and capacity	· Access to routine healthcare · Access to healthcare due to emergency situations and overwhelming local and regional healthcare capacities	Figure 3.22-3

3.22.2 APPROACH

The majority of the information presented for the scoping and baseline assessment of health is drawn from the two sources listed below:

- NewFields 2015. Draft Health Impact Assessment, Baseline Community Health Data Assessment, Donlin Gold Project. Prepared for ADHSS Health Impact Assessment Program.
- Alaska Department of Health and Social Services (ADHSS). 2013. Donlin Hair Mercury Summary for Eight Communities. Draft Report.

The baseline information developed by NewFields (2015) is extensive and covers a wide range of indicators within each HEC. The date of the most recent information varies from 2007 to 2011, depending on HEC; and in many cases, older data are also examined. The discussion that follows presents a summary of the information for the HECs from NewFields (2015). In some cases, the information presented in NewFields (2015) was updated or supplemented by reference to other publicly available sources.

Potential exposure to mercury (associated with mining activities) is a health concern expressed by stakeholders. Therefore, baseline data on current levels of mercury in the potentially affected community (as expressed by mercury in hair samples) provide valuable baseline information. Data from a study undertaken by the ADHSS HIA Program in the eight communities near the mine site are also included as part of the baseline health section.

The organization of the summary of baseline health conditions is as follows:

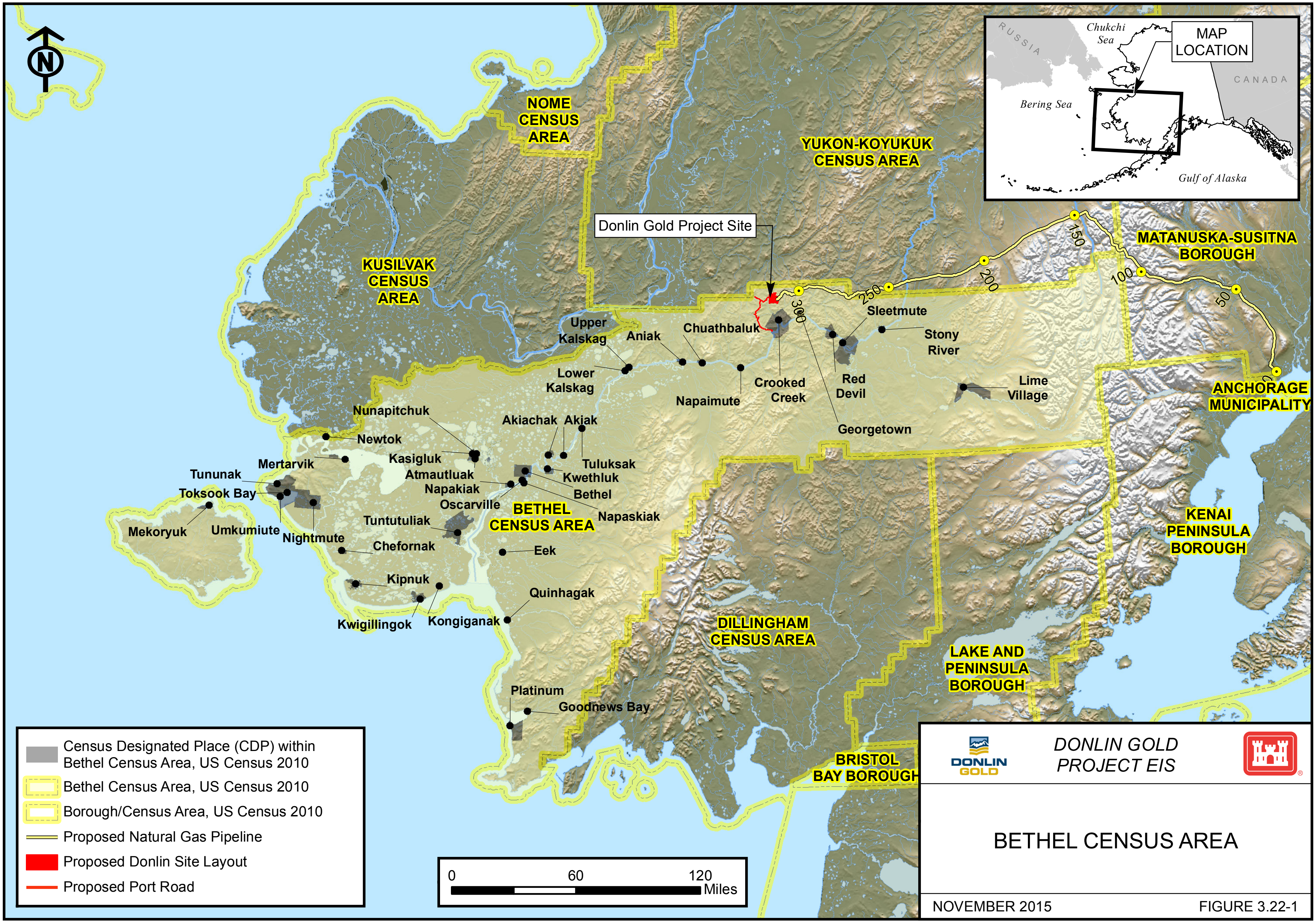
- The general affected environment is presented, based on the three project components: mine site infrastructure and processes, transportation facilities, and natural gas pipeline.

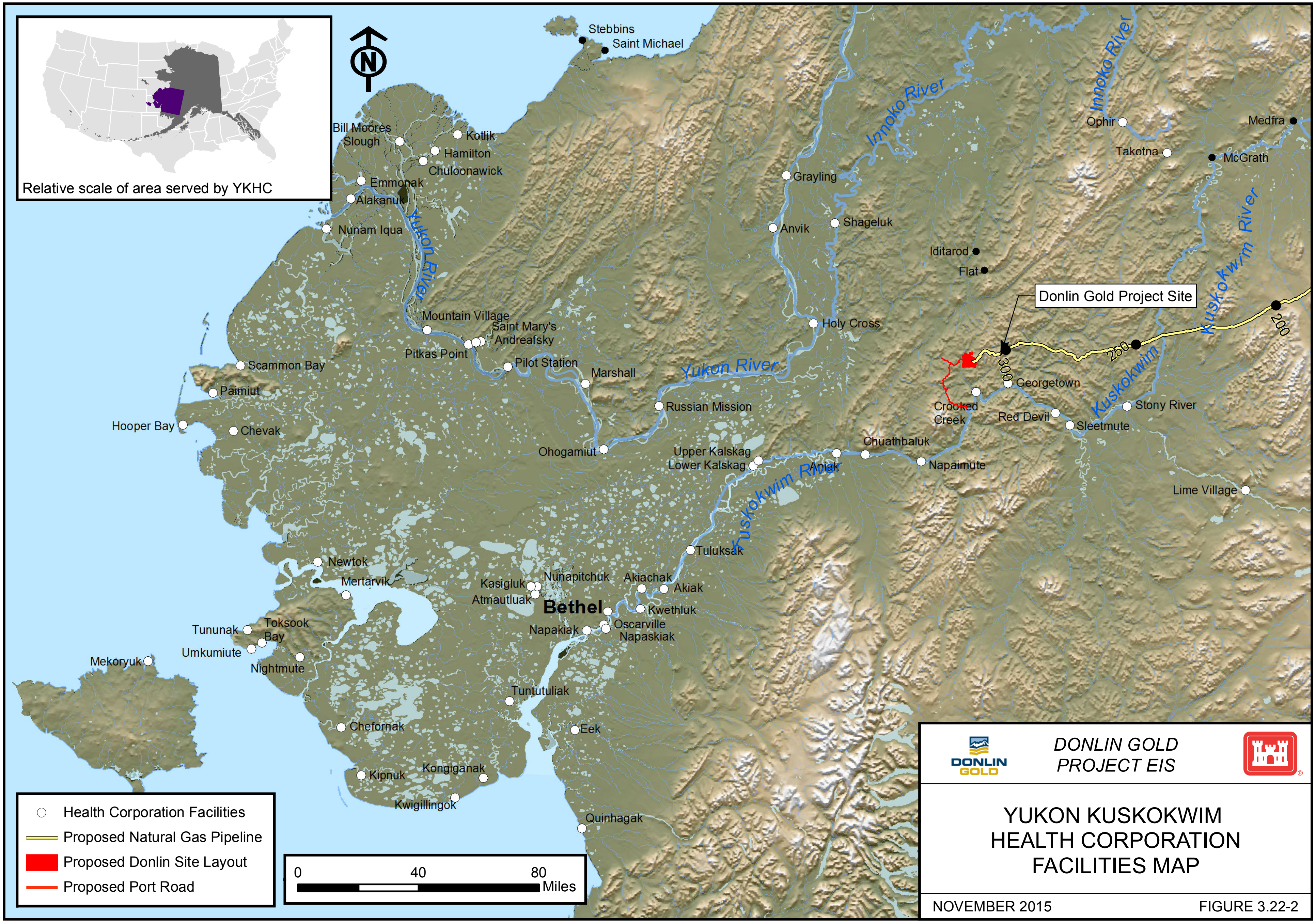
- Discussions of the general baseline community health conditions by HECs are presented.
- Only health impact issues that appeared to be most relevant or appropriate to the project description and the affected communities were included in the baseline and carried forward for the impact assessment.
- As needed, HECs with multiple health impact issues will have a summary table listing the values used in the HEC discussion.

3.22.3 AFFECTED ENVIRONMENT

Identifying Potentially Affected Communities: The potentially affected communities are identified in relation to the three components of the Donlin Gold Project and then by the regions and smaller communities potentially affected by each component. The reach of the project components is largely based on geographic location and proximity. The limitation to this approach is that some effects may not be directly related to the length of distance between the community and the project component. Examples of such instances would be employment opportunities, and the significance of the changes caused by the project. Although the direct economic effects are discussed in Section 3.18, Socioeconomics, the relationship between income and health cannot be overstated. The substantial distances (including terrain) and the planned onsite housing camps, makes traditional commute times irrelevant and therefore the communities that would contribute to the workforce may include more than those closest to the site. Also not directly related to distance would be changes within a community such as the City of Bethel where a new dock at the Bethel Port site is proposed as part of the transportation facilities. These factors that are not dependent on distance also warrant consideration along with the communities generally located close to the project components.

The Donlin Gold Project covers a relatively large geographical distance (for example, the proposed natural gas pipeline extends over 300 miles in length) and considers effects to broad rural areas. Health data are not always available at the community or regional level for many of the potentially affected communities. These limitations are typical of health data, due to privacy concerns and very small community sizes. These are not considered to be severe limitations for the purposes of the EIS. For the EIS, these limitations are addressed by using two broad regional data sources: Bethel Census Area (Figure 3.22-1) and The Kuskokwim Corporation (TKC) (which is part of the Yukon-Kuskokwim Health Corporation Service Area [YKHC]) (Figure 3.22-2) for overall coverage. The smaller, relatively nearby communities (some with only 20 occupied housing units) are discussed when data were available. These represent the small communities along the central Kuskokwim River which are relatively close to project components and may be more directly impacted both positively and negatively than communities further away.


N
NOME CENSUS AREA
YUKON-KOYUKUK CENSUS AREA
KUSILVAK CENSUS AREA
MATANUSKA-SUSITNA BOROUGH
ANCHORAGE MUNICIPALITY
BETHEL CENSUS AREA
KENAI PENINSULA BOROUGH
DILLINGHAM CENSUS AREA
LAKE AND PENINSULA BOROUGH
BRISTOL BAY BOROUGH
MAP LOCATION
Chukchi Sea
RUSSIA
CANADA
Bering Sea
Gulf of Alaska
Donlin Gold Project Site
150
200
100
50
250
300
Upper Kalskag
Aniak
Chuathbaluk
Sleetmute
Stony River
Lower Kalskag
Napaimute
Crooked Creek
Red Devil
Lime Village
Georgetown
Nunapitchuk
Akiachak
Akiak
Newtok
Kasigluk
Tuluksak
Mertarvik
Atmautluak
Kwethluk
Tununak
Napakiak
Bethel
Toksook Bay
Oscarville
Napaskiak
Tuntutuliak
Mekoryuk
Umkumiute
Nightmute
Chefornak
Eek
Kipnuk
Quinhagak
Kwigillingok
Kongiganak
Platinum
Goodnews Bay
Census Designated Place (CDP) within Bethel Census Area, US Census 2010
Bethel Census Area, US Census 2010
Borough/Census Area, US Census 2010
Proposed Natural Gas Pipeline
Proposed Donlin Site Layout
Proposed Port Road
0
60
120
Miles
DONLIN GOLD
DONLIN GOLD PROJECT EIS
BETHEL CENSUS AREA
NOVEMBER 2015
FIGURE 3.22-1



YUKON KUSKOKWIM HEALTH CORPORATION FACILITIES MAP

NOVEMBER 2015 FIGURE 3.22-2

Mine Site Infrastructure and Processes. The mine site would include many structures such as a planned airstrip, new roads, and the buildings and factories to support the mining operations (see Figure 2.3-6). Currently, there are no direct public roads from the mine site area to nearby communities. The nearest community to the mine site is located 10 miles south at the Middle Kuskokwim River village of Crooked Creek (about 280 miles northwest of Anchorage). Potentially affected regions and communities are:

- Bethel Census Area (population of 17,746 (2012) and an area of 40,570 sq. mi. and density of 0.4 persons per sq. mi. [USCB 2013d])
- YKHC service area (covers an area approximately a quarter of the state) also includes the Y-K region.
- Eight small central Kuskokwim River communities: Aniak, Chuathbaluk, Crooked Creek (closest community at approximately 10 miles from the mine site), Upper Kalskag, Red Devil, Sleetmute, Stony River, and Lower Kalskag (furthest community at approximately 80 miles from the mine site).

Transportation Facilities. The transportation facilities component encompasses the pathway of the supply chain for the mine site infrastructure and processes. The planned route has sea vessels leaving Canadian and Pacific northwestern US ports and traveling to Dutch Harbor port and then into the Kuskokwim Bay, up-river to Bethel, transferring cargo from sea vessels to river barges, and along the Kuskokwim River to the docks at Angyaruaq (Jungjuk) Port site near the mine site (Figure 2.8 in Chapter 2, Alternatives).

Overall, potentially affected regions and communities for the transportation component are divided into three functional categories as follows:

Mine Site and Riverbank Communities

- Bethel Census Area;
- YKHC Service Area; and
- Small central Kuskokwim River communities listed under mine site infrastructure and processes (Aniak, Chuathbaluk, Crooked Creek, Lower Kalskag, Red Devil, Sleetmute, Stony River, and Upper Kalskag) along with the down river communities of Napaimute, Tuluksak, Akiak, Akiachak, Kwethluk, Oscarville, Napaskiak, and Napakiak.

Ocean to River Barge Transfer / Storage Location

- City of Bethel

Ocean Port Location

- Dutch Harbor (City of Unalaska in the Aleutian West Census Area)

Health data coverage is derived from regional sources for the numerous small communities that may be affected by the transportation component. The regional sources include data for the Y-K region and for the Bethel Census Area.

There is considerable overlap in communities affected by the mine site and the transportation facilities components (Bethel Census Area, YKHC Service Area, and central Kuskokwim River communities). The Y-K region is comprised of approximately 50 small villages and there may be an additional 30 small communities from Stony River to Platinum (Calista Corporation 2014b).

The Bethel Census Area covers the communities and cities not listed in the draft version of the NewFields HIA such as the communities down river (e.g., Napaimute, Tuluksak, Akiak, Akiachak, Kwethluk, Oscarville, Napaskiak, and Napakiak), the City of Bethel, and Dutch Harbor. Limited information is available at the community level for the baseline data; therefore the central Kuskokwim River communities, Bethel and Dutch Harbor, would be mostly covered by the Bethel Census Area information. The central Kuskokwim River communities share similar characteristics and are comprised predominantly of Alaska Natives, as noted in Section 3.19, Environmental Justice (USCB 2013c, d). The City of Bethel is a hub in the Y-K region, with approximately one-fifth of the region's population (USCB 2013e). The demographic and socioeconomic profiles for the City of Bethel are slightly more diverse in comparison to the smaller communities in the region, but generally more aligned with the region than state averages (USCB 2013c, d). Dutch Harbor is a major sea port for Alaska.

Natural Gas Pipeline. The proposed 14-inch steel pipeline would be 315 miles long, originating near Beluga and terminating at the Donlin Gold mine site (Fig 2.2-7a). It would be buried for the majority of its length and would be located within an approximately 50-foot wide easement within State of Alaska and Bureau of Land Management (BLM) lands and is generally remote from communities and settlements. As apparent from the figure, potentially affected regions and communities include:

- Kenai Peninsula Borough (KPB) communities of Beluga and Tyonek (communities closest to the eastern terminal of the pipeline);
- the Matanuska-Susitna Borough (MSB) communities of Susitna and Skwentna (region near the eastern terminal of the pipeline);
- the Yukon-Koyukuk Census Area communities of McGrath, Nikolai, and Takotna (small communities approximately 50 miles north of the pipeline); and the
- Bethel Census Area communities of Crooked Creek, Red Devil, Sleetmute, and Stony River (small communities approximately 25 miles from the pipeline and are overlapping communities from mine site infrastructure and processes).

3.22.3.1 DEMOGRAPHIC SUMMARY OF POTENTIALLY AFFECTED COMMUNITIES

Demographic and socioeconomic profiles of the affected communities are presented in Sections 3.18, Socioeconomics, and 3.19, Environmental Justice, and the information is not repeated in detail here. Section 3.18, Socioeconomics, contains tables of information for potentially affected communities, including Table 3.18-2 of population and age statistics, Table 3.18-3 of education statistics, and Table 3.18-5 of income and unemployment statistics. To provide context for the human health analysis, a summary of the demographic data is presented in Table 3.22-2. The Y-K region had a total population of 19,345, Bethel Census Area had a population of 17,013 (88 percent of Y-K region), and Kuskokwim River communities had a population of 9,140 (5 percent of Y-K region). The ethnicity for the Y-K region was predominantly comprised of Alaska Natives (79 to 97 percent), in comparison with the statewide estimate of 19.1 percent. These areas had younger populations (median age 26.2 years [Bethel Census Area] to 24.1 years [Y-K region]) compared to the state median of 33.8 years. They also had lower educational levels; an estimated 14 to 18 percent did not complete high school compared to 7 percent in the state; 7 to 13 percent earned college degrees compared to 28 percent of residents in the state. The region also had lower median annual incomes ($21,992 to $32,108), and higher unemployment rates (15.0 to 20.7 percent) in comparison to state averages for median annual income ($45,665) and unemployment (7.6 percent). Statistics for the City of Bethel (population 6,080) are more diverse than for the smaller communities, but are generally similar (USCB 2013c, d; ADOL 2013c, d).

Table 3.22-2: Demographic Summary

Subject	Community Bethel Census Area	Community KPB	Community MSB	Regional (Y-K region or as noted)	Alaska	National
Percent Alaska Native Population	79% to 97%	--	--	79% to 97%	19.1	--
Percent White Population	--	83%	83%	--	61.1%	
Median Age	26.2 years	40.6 years	34.8 years	24.1 years	33.8 years	--
Did Not Complete High School	14% to 18%	6%	6%	14% to 18%	7%	--
Earned College Degrees	7% to 13%	23%	21%	7% to 13%	28%	--
Median Annual Income	$21,992 to $32,108	$41,772	$41,905	$21,992 to $32,108	$45,665	--
Unemployment Rate	15.0% to 20.7%	9.4%	8.8%	15.0% to 20.7%	7.6%	--

Notes:

-- = Not Available and/or Not Used
KPB = Kenai Peninsula Borough MSB = Mat-Su Borough

The KPB and MSB are predominantly white (82.8 percent for both) in comparison with the statewide estimate of 64.1 percent white. The median age in these areas is older (40.6 years [KPB] to 34.8 years [MSB]) than the state median age of 33.8 years. Educational levels are similar to or slightly lower than state averages for high school and college completion. For both KPB and MSB, 6 percent did not complete high school and 23 percent earned higher degrees in the KPB and 21% for MSB. Median incomes ($41,772 KPB and $41,905 MSB) were slightly lower than the state median income ($45,665), and unemployment rates (9.4 percent KPB and 8.8 percent MSB) were slightly higher than the state average (7.6 percent Alaska). Dutch Harbor (City of Unalaska, population 4,376) is a diverse city with a mixture of white, Hawaiian Islander, African-American, Alaska Native, and other groups, with a higher median age (40.7 years), lower median income ($30,334), and lower unemployment rate (3.1 percent) when compared to the state averages (USCB 2013c, d; ADOL 2013c, d). Dutch Harbor demographics are shown in Table 3.22-3.

Table 3.22-3: Dutch Harbor Demographics

Subject	Community Dutch Harbor	Alaska
Median Age	40.7 years	33.8
Median Income	$30,334	$45,665
Unemployment Rate	3.1%	7.6%

3.22.3.2 STAKEHOLDER CONCERNS ABOUT HEALTH

Identifying and addressing stakeholder concerns about health are key aspects of the scoping phase of the health impact assessment process. Personnel from ADHSS, NewFields, and representatives from community organizations undertook a variety of activities to elicit information on stakeholder concerns about health for this project (NewFields 2015). They included public meetings, community meetings, and Internet searches.

Stakeholder concerns were more commonly expressed in the area for four HECs: social stresses and benefits, accidents and injuries, exposure to hazardous chemicals, and changes to subsistence patterns. There were fewer concerns regarding communicable and non-communicable diseases, water and sanitation, and health services infrastructure. Stakeholders' expectations of positive health benefits included the potential for improvements in social and mental health related to increased employment and income and better transportation access to healthcare facilities. Concerns about negative health impacts included possible increases in alcohol and drug use with increasing disposable income, family and marital stress related to employment schedules, changes to traditional ways of life and impacts on subsistence activities and nutrition, increases in accidents and injuries related to barge traffic, and potential exposure to hazardous chemicals associated with mining operations (e.g., arsenic, cyanide, mercury). Local residents stressed the need for the health impact assessment process to encompass all aspects of their lives, as highlighted during the Akiak Scoping Meeting:

> in terms of human health, we have to make sure that we do an assessment on health impacts or health status of the community, alcohol, physical health, emotional health, spiritual health, and make sure that we have that data, and to make sure that it doesn't have an impact in diminishing the status of our health, but to increase the status, health status of our people physically, emotionally, mentally, et cetera. (URS 2013b)

In addition to local communities, three environmental groups were found to have an interest in the Donlin Gold Project: the Donlin Gold Working Group, Northern Alaska Environmental Center, and Ground Truth Trekking (NewFields 2015).

3.22.3.3 BASELINE COMMUNITY HEALTH CONDITIONS: HEALTH EFFECTS CATEGORIES

Information for the potentially affected communities is presented and compared to other local and regional data as warranted and also compared to state or U.S. data. Primary data sources listed in NewFields (2013) and in this section include the World Health Organization (WHO), U.S. Census Bureau (USCB), U.S. Centers for Disease Control and Prevention (CDC), Alaska Bureau of Vital Statistics (BVS), ADHSS sources, Alaska Department of Environmental

Conservation (ADEC), Alaska Department of Fish and Game (ADF&G), Alaska Office of Children's Services (OCS), Alaska Native Regional Health Status Reports produced by the Alaska Native Tribal Health Consortium (ANTHC), Alaska State Troopers (AST), Regional Health Profile for YKHC, and other government and academic sources. Although statewide data offers some context, the HEC discussions in this HIA are limited to health endpoints which have relevant and current (within the last 5 years) regional and local data available. Although current data are generally preferred, older data are presented as warranted or if current data were not available. In most cases, local data are neither reported nor available due to small size or privacy concerns.

3.22.3.4 MINE SITE

The mine site includes the proposed open pit mine, overburden stockpile, WRF, ore processing facilities, TSF, and power plant, utilities, services and infrastructure. The mine site activities are sequenced into the construction, operations, and closure (and reclamation) phases. Chapter 2, Alternatives, presents project description details, and a summary of the potentially affected communities for this component was presented above.

3.22.3.4.1 HEC 1: SOCIAL DETERMINANTS OF HEALTH (SDH)

The following social health determinants represent a comprehensive and regionally relevant baseline. In most cases, the Yukon-Koyukuk and Bethel census areas were compared to state or U.S. data. For cases where regional data are not available, data for Alaska Natives is viewed as an indicator for the affected communities as they are the majority of the population of the Y-K region and Bethel Census Area (USCB 2013d). The ADHSS 2011 Technical Guide suggests a broad list of SDHs for consideration, of which many are discussed in this section. SDHs such as isolation and cultural change were not included due to the lack of meaningful available data on these topics at the level of community health. However, these topics are also addressed in larger context in the sections on Cultural Resources (Section 3.20) and Subsistence (Section 3.21).

Life Expectancy. Life expectancy is a standard metric of community health status. According to the Alaska Native Epidemiology Center (ANTHC 2013), data for 2004 to 2008 show Alaska Native population life expectancy (at birth) to be notably lower at 70.5 years as compared to Alaska white population and U.S. white population at 77.7 years and 78.3 years, respectively. The ANTHC data (2013) show that for the same time period amongst Alaska Natives, the life expectancy range was narrow and equivalent to the statewide Alaska Native population life expectancy of 70.5 years, with the range being between 67.6 years (Arctic Slope region) and 72.6 years (Southeast region), and the Y-K region falling in the middle at 70.0 years. Since 1980, overall life expectancy rates have climbed at a similar rate for all study groups across regions, ethnicities, and races (ANTHC 2013).

Maternal and Child Health. Maternal and child health are important indicators of a community's wellness and access to healthcare since they are influenced by many factors. The key indicators compared between Bethel Census Area and the state were infant mortality, adequacy of prenatal care, low birth weight, substance use during pregnancy, and teen pregnancy. The Bethel Census Area infant mortality rate of 10.8 (per 1,000 births) was based on only 21 counts from 2007 to 2009, but were higher than both state (6.3) and U.S. (6.75) rates (ADHSS undated, as cited in NewFields 2015). Comparisons of statewide rates with rates projected from very small populations should be interpreted with caution due to the high statistical uncertainty associated with small populations. The adequacy of prenatal care utilization (APNCU) index compares the number of prenatal visits with the expected number of visits for the period when care began and the delivery date.

To classify the adequacy of received services, the number of prenatal visits is compared to the expected number of visits for the period between when care began and the delivery date. The expected number of visits is based on the American College of Obstetricians and Gynecologists prenatal care standards for uncomplicated pregnancies and is adjusted for the gestational age when care began and for the gestational age at delivery. A ratio of observed to expected visits is calculated and grouped into four categories— Inadequate (received less than 50 percent of expected visits), Intermediate (50–79 percent), Adequate (80–109 percent), and Adequate Plus (110 percent) (BVS 2009). "Adequate prenatal care" is defined as care that begins in the first trimester and includes nine visits throughout the pregnancy. "Inadequate prenatal care" is defined as beginning in the third trimester and includes no more than four visits (BVS 2009).

The Bethel Census Area had a higher percentage of inadequate prenatal care at 23.1 percent than the state (17.2 percent) with Alaska Native mothers faring worse than white mothers across all reported metrics. The Bethel Census Area recorded a higher percentage of infants born from mothers who smoked, which increases the chance of low birth weights, as compared to the state (22.3 percent compared to 14.5 percent) (ADHSS undated, as cited in NewFields 2015). There was little difference between Bethel Census Area and the state in terms of low birth weight (5.1 percent compared to 5.9 percent, respectively) and alcohol use by pregnant women (2.1 percent compared to 2.9 percent, respectively). For Alaska Native teen pregnancies (under 20 years old) rates amongst Alaska Natives and the state were also similar (12.4 percent compared to 12.7 percent, respectively) (AN Epicenter 2007; ADHSS undated, both as cited in NewFields 2015).

Abuse and Sexual Violence. Abuse and violence are linked to physical, social, and mental health. There are limited local data available for child abuse and only associations could be made for the Bethel Census Area based on the regional grouping by OCS. The Western Region of Alaska (includes the Bethel Census Area), when compared to the other five regions, had the highest rates for both substantiated allegations of child abuse (450 per 10,000 children) and child abuse victims (216 per 10,000 children) (OCS 2010, as cited in NewFields 2015). The sexual violence rate in Alaska is 2.3 times higher than the U.S. rate (2010 Alaska Victimization Survey, as cited in NewFields 2015). Rates specifically for Alaska Native women (31 percent compared to all races at 22.4 percent) and rural areas (26 percent for rural compared to 23 percent for Anchorage and 19 percent for Fairbanks) were mixed, but showed higher rates of reported intimate partner violence compared to total populations and urban locations (ADHSS 2006, as cited in NewFields 2015).

Oral Health. General oral health covers oral and pharyngeal cancer, gingivitis, periodontal disease, cavities which are directly related to access to dental care, fluoridation of drinking water, and education. In 2008, 20 percent of Alaska Natives visited the dentist as compared to the national percentage of 65.1 percent for all races (AN Epicenter 2009; U.S. Dept. of Health and Human Services 2000, as cited in NewFields 2015). The low percentage affects oral health education and prevention, early detection of lesions or tumors, and overall lack of dental care. High tobacco and soda use and low rates of drinking water fluoridation amongst Alaska Natives and remote regions are also contributing factors for oral health concerns. For example, children without fluoridated water have up to 3 times the amount of cavities, decay, and other dental problems than children in villages with fluoridated water (CDC 2011, as cited in NewFields 2015).

Suicide. Suicide rates are an indicator of mental health wellness within communities. For the Bethel Census Area, suicide ranked fourth in leading causes of death. Suicide was sixth in leading causes of death in the State of Alaska from 2007 to 2009. For Alaska Natives ages 5 to 14, suicide ranked third in leading causes of death; for ages 15 to 34 suicide ranked second in leading causes of death; and for ages 35 to 44 suicide ranked third in leading causes of death. The age-adjusted rate of suicide deaths per 100,000 U.S. Year 2000 standard population was 61.6 for the Bethel Census Area and 22.7 for the State of Alaska (BVS 2011, as cited in NewFields 2015).

Substance Abuse. Substance abuse refers to the consumption of mind and behavior altering substances (NewFields 2015). Rates of excessive drinking, which includes both binge-drinking and heavy drinking for the Bethel Census Area were 17 percent which was lower than the state at 19 percent (AN Epicenter 2007, as cited in NewFields 2015). Male adult binge drinking rates were double that of females among YKHC service area residents. Alaska Natives between 25 to 34 years of age had the highest self-reported rates of binge drinking (18 percent) of all age groups (University of Wisconsin 2011, as cited in NewFields 2015).

Alaska Native high school students typically report higher rates of marijuana use (32 percent) than Alaska non-native high school students (17 percent). However, rates of alcohol, marijuana, and cocaine usage are comparable among these two groups. It is inferred that these trends would be similar in the current mine site communities (AN Epicenter 2009, as cited in NewFields 2015).

Economic Indicators. The Socioeconomic (Section 3.18) and Subsistence (Section 3.21) sections discuss the relevant factors for the project description and the potentially affected communities. Section 3.22.3.1 summarizes median household income for the region. It should be noted that these income metrics do not include any dollar equivalent of subsistence resources which are vital resources for this region and especially the small rural communities (see Section 3.18, Socioeconomics). Section 3.21.1 discusses the monetary value equivalence for subsistence activity. Positive linkages have been acknowledged between diets based on a subsistence lifestyle (e.g., consumption of fish and caribou) and the generally positive health benefits associated with such diets (ADHSS 2011).

Accurate employment data are difficult to ascertain due to strict reporting requirements that preclude some of the population, the remoteness of the region, and the seasonal aspect of local job opportunities. There is generally a lack of local employment opportunities for the region, especially at the small Kuskokwim River communities (Martin et al. 2008). Section 3.22.3.1 presents a summary of employment data for the communities and the region as compared to the state. Section 3.18 presents the socioeconomics subjects in more detail.

Educational Attainment. The positive relationship between educational attainment and health has been well-documented (Cutler and Llera-Muney 2007; Hernandez-Murillo and Martinek 2011). Section 3.22.3.1 presents general education data for the region. The percentage of adults who are high school graduates varies considerably among the eight central Kuskokwim River communities, from a low of 33 percent in Stony River to a high of 100 percent in Red Devil.

Only Red Devil had higher education rates than the state (ADOL&WD, ACS 2009; UCB 2000, both as cited in NewFields 2015).

Family Stability. Family stability can be a determinant of social and mental health, particularly for children. The divorce rate for the state was almost 7 times higher than for the Bethel Census Area in 2009 (ADHSS undated, as cited in NewFields 2015). Bethel Census Area (14.0 percent) also had equivalent percentages of women-head-of-household (no father) as the state (16.2 percent). For the small Kuskokwim River communities, the range of women-head-of-households had a much larger disparity from 17.5 percent (Aniak) to 50 percent (Crooked Creek) as compared to the state having 16.2 percent (ADOL&WD, ACS [2005-2009], as cited in NewFields 2015). Social determinants of health are shown in Table 3.22-4.

Table 3.22-4: Social Determinants of Health

Subject	Community (Bethel Census Area or as noted)	Regional (Y-K region or as noted)	Alaska	National
Life Expectancy (yrs)	NA	70.5 yrs (AN)	77.7 yrs (White)	78.3 yrs (White)
Infant Mortality (Mortalities per 1,000 births)	10.8	--	6.3	6.75
Inadequate Prenatal Care (percent all races)	23.1%	--	17.2%	--
Inadequate Prenatal Care (percent AN and White)	37.5% (AN) 0.0% (White)	--	24.2% (AN) 13.1% (White)	--
Low Birth Weight (percent)	5.1%	--	5.9%	8.16%
Births from Pregnant Mothers Who Smoked (percent)	22.3%	--	14.5%	--
Births from Pregnant Mothers with Alcohol Use	2.1%	--	2.9%	--
AN Teen Pregnancy (percent)	12.4%	--	12.7%	--
Allegations of Child Abuse per region (rate per 10,000)	--	**450 (Western)** 292 (Anchorage) 292 (Northern) 243 (Southcentral) 192 (Southeastern)	--	--
Victims of Child Abuse (rate per 10,000)	--	**216 (Western)** 106 (Anchorage) 139 (Northern) 101 (Southcentral) 71 (Southeastern)	--	--
Intimate Partner Violence (percent by race)	--	--	31% (AN) 22.4% (all races)	--
Intimate Partner Violence (percent by region)	--	**26% (rural)** 23% (Anchorage) 19% (Fairbanks)	--	--
Visited the Dentist (percent of noted population)	--	--	20% AN	25.0% (AI & AN) 65.1% (all races)
Suicide (rate per 100,000)	61.6	62.1	22.7	--
Reported Excessive Drinking (percent)	17%	--	19%	--

Table 3.22-4: Social Determinants of Health

Subject	Community (Bethel Census Area or as noted)	Regional (Y-K region or as noted)	Alaska	National
Binge Drinking (percent by sex)	--	16% (male) 8% (female)	--	--
Binge Drinking (percent by age group)	--	18% (AN 25-34)	--	--
High School Student Marijuana Use (percent)	--	--	32% (AN) 17% (non-AN)	-
Unemployment (percent)	11.3%	--	5.9%	--
High School Diploma or Higher (percent)	79.1%	--	90%	--
Divorce (rate per 1000)	1.7 (male) 1.3 (female)	--	7.3 (male) 7.9 (female)	--
Female Head of Household (percent of family households)	14.0%	--	16.2%	--

Notes:

Bold used to specify region of interest
AI = American Indian
AN = Alaska Native
-- = Not Available and/or Not Used
yrs = years

3.22.3.4.2 HEC 2: ACCIDENTS AND INJURIES

Accidents and injuries include both fatal and non-fatal incidents that are primarily unintentional and affect the mortality and morbidity rates of a community. Intentional incidents include suicide and homicide.

Fatal Injuries. The data, rates, and statistics for injuries are based on relatively low counts (for example there were 39 fatal injuries over three years [2007-2009] in the Bethel Census Area) and therefore calculated rates should be weighed carefully. For the Bethel Census Area, the leading cause of fatal injury is alcohol overdose (grouped under "poisoning" by Alaska BVS [2007-2009]) showing an age-adjusted rate 1.5 times higher than the state. Alcohol abuse is also associated with the other leading causes which were motor vehicle accidents (the majority are snow machine accidents) and drowning. Suicide, as noted by the Alaska Trauma Registry (ATR), while not unintentional, was the most common cause of fatal injuries in the Bethel Census Area (ADHSS undated; ATR 2011, both as cited in NewFields 2015).

Non-fatal Injuries. During 2004 to 2008 for the Y-K region, the most common cause of non-fatal injury requiring hospitalization was attempted suicide (23 percent of all non-fatal injuries), followed by falls (22 percent), and assault (10 percent). These three causes of injury alone accounted for 55 percent of all non-fatal injuries during this period (ATR 2011, as cited in NewFields 2015).

Law Enforcement. There are police stations in Bethel and Aniak. The city of Bethel has its own police department and also staffs 12 ASTs and uses air taxis to service the nearby villages; the community of Aniak staffs 4 AST officers and 2 Village Public Safety Officers (VPSOs) and services 14 nearby village communities (AST 2010, as cited in NewFields 2015). Law enforcement response times to incidents in nearby villages can be prolonged; even with travel via air taxi, responses can have delays of greater than one hour.

Dry/Wet/Damp Community. The role of alcohol in accidents and injuries is well-known (Landen et al., 1997 as cited in NewFields 2015). Alaska Native villages have enacted policies that designate a community as dry (no sale or consumption), damp (no sale, but possession allowed), and wet (sale, importation, and possession allowed). As of June 2011, three central Kuskokwim River communities have adopted "local option laws" to prohibit alcohol: Lower Kalskag (dry), Upper Kalskag (damp), and Red Devil (damp). Alcohol is permitted in the remaining five central Kuskokwim River communities (wet) (ADPS, ABC Board 2011, as cited in NewFields 2015).

Transportation-related Accidents. Section 3.23, Transportation, discusses marine and riverine incidents, such as accidents and spills, with Table 3.23-2 giving information on U.S. Coast Guard incident investigation reports for the Kuskokwim River and Kuskokwim Bay. The table lists nine incidents occurring between 2002 and 2009. All but two of the incidents involved groundings (the remaining two incidents were a collision that damaged a vessel and a fatal onboard fishing vessel accident). An additional incident occurred June 4, 2015, where a barge was grounded near Kuskokwim Bay carrying an estimated 68,000 gallons of fuel. The U.S. Coast Guard found no damage to the tanks or hull, and identified no pollution resulting from the incident (Alaska Dispatch News 2015b).

The Bethel Harbor had an average of 111.8 inbound and outbound trips by self-propelled vessels between 2007 and 2011. Table 3.23-3 in Section 3.23, Transportation, has complete data for commercial vessel trips in the Bethel Harbor. Between 2007 and 2011, an average of 405 commercial vessel trips was logged annually on the Kuskokwim River, with 187 trips being self-propelled vessels. Tables 3.23-4, 3.23-5, 3.23-6, 3.23-7, and 3.23-8 in Section 3.23, Transportation, contain information about Kuskokwim River vessel traffic.

At Dutch Harbor, the Unalaska Department of Ports and Harbors manages six marine facilities. Section 3.23, Transportation, describes these facilities and notes Unalaska Island marine traffic included 1,423 total domestic trips in 2009 (City of Unalaska 2009). Accidents and injuries are shown in Table 3.22-5.

Table 3.22-5: Accidents and Injuries

Subject	Community (Bethel Census Area or as noted)	Regional (Y-K region or as noted)	Alaska	National
Fatal Injury: Poisoning (rate)	24.1	--	16.9	--
Attempted Suicide (percent)	--	23%	--	--
Nonfatal Falls (percent)	--	22%	--	--
Nonfatal Assault (percent)	--	10%	--	--

Notes:

-- = Not Available and/or Not Used

3.22.3.4.3 HEC 3: EXPOSURE TO POTENTIALLY HAZARDOUS MATERIALS

Environmental exposure to chemicals or physical hazards through the air, land, or water is also considered a health determinant. Baseline data may be qualitative in terms of proximity to known contamination sources, or quantitative through analytical data collection and monitoring such as the ADHSS methylmercury testing of hair samples from pregnant women (NewFields 2015).

Physical Hazards. There are no specific data on physical hazards (NewFields 2015), but it should be recognized that the rural and remote regions in Alaska carry exposure risk to the elements and wildlife.

Air Quality. The role of poor air quality on community health, particularly with regard to respiratory disorders, has been well-documented (WHO 2011). There were no specific data available on air quality for the EIS Analysis Area (NewFields 2015). Due to the extreme cold and frozen ground, local practices of burning trash and running diesel generators could contribute to poor air quality outdoors. The lack of paved roads may circulate pollutants in dust which affects air quality and may also settle on food sources. There are also indoor air quality issues with the use of old wood burning stoves which may be made worse by spending a lot of time in airtight homes (NewFields 2015).

Water Quality. “The State of Alaska has some of the highest levels (up to 10,000 µg/liter) of naturally occurring arsenic in drinking water in the U.S.” (Harrington et al. 1978, as cited in NewFields 2015). In 2005, out of the 60 regulated public water systems in the Y-K basin, 19 exceeded arsenic screening levels (ADEC 2010, as cited in NewFields 2015). Due to historic mining at Red Devil mine, lengths of the middle Kuskokwim River exceed screening levels for mercury, arsenic, and antimony which affect water quality and forces fish advisories (ADHSS 2010, as cited in NewFields 2015). While no water bodies in the EIS Analysis Area listed as impaired under Section 303(d) of the federal Clean Water Act, the Kuskokwim River is listed as a Category 5 impaired water body under state water quality standards at the outflow of Red Devil Creek. The designation extends 100 feet upriver to 900 feet downriver from the confluence of Red Devil Creek and the Kuskokwim River. This designation requires a Total Maximum Daily Load technical analysis to calculate pollution reductions. See Section 3.7, Water Quality, for additional information on this topic.

Potentially Hazardous Materials. The ADHSS monitors for mercury which is a naturally occurring metal that may be released into the environment from mining processes (ATSDR 1999, as cited in NewFields 2015). Since 2002, the ADHSS Biomonitoring Program has been testing the hair of pregnant women and women of child-bearing age for methylmercury (NewFields 2015).

<u>ADHSS Mercury Biomonitoring (2002-2010)</u>

From 2002 to 2010, ADHSS tested 308 pregnant women and 505 women of childbearing age throughout Alaska (113 communities). The Southwest Region, which includes the YKHC service area and the Bethel Census Area, showed a median hair methylmercury level of 0.78 parts per million (ppm) with a maximum of 7.82 ppm; both levels were below the Agency for Toxic Substances and Disease Registry (ATSDR) screening level of 15.3 ppm (ADHSS 2010, as cited in NewFields 2015).

ADHSS Hair Mercury Monitoring (2012) in Potentially Affected Communities

The HIA Program conducted fieldwork in the summer and fall of 2012 in Aniak, Upper Kalskag, Lower Kalskag, Crooked Creek, Sleetmute, Chuathbaluk, Stony River, and Red Devil. The HIA program collected 186 hair samples from 8 communities. The median hair mercury level for the study population was 0.510 ppm, with a range of 0.030-3.707 ppm (Table 3.22-6). Every study participant had a hair mercury level that was below the ATSDR No Observed Adverse Effect Level (15.3 ppm), as well as the Environmental Public Health Program cut-off for follow-up (5 ppm) (ADHSS 2013).

Table 3.22-6: Summary of Data Collected by Gender, Donlin Gold, 2012

Population	Number of Samples	Mean Age (years)	Age Range (years)	Median Hg (ppm)	Range Hg (ppm)
Total	186	44	15-74	0.510	0.030-3.707
Male	41	50	22-74	0.768	0.126-3.640
Female	145	43	15-74	0.557	0.033-3.707

Males had a median hair mercury level that was 0.211 ppm higher than females, though this difference was not statistically significant (p-value=0.203). The hair mercury concentrations were weakly but positively correlated with age (Pearson Correlation=0.28, p-value=0.00). Age accounted for 7.9 percent of the variance of hair mercury concentrations. For every year increase in age, hair mercury concentrations increased by 0.012 ppm (p-value=0.00, 95percent CI=0.006-0.019) (ADHSS 2013).

The median hair mercury level found in this study (0.510 ppm) was similar to the state median level (0.46 ppm), and was lower than the median levels observed in the Southwest Region (0.78 ppm) (ADHSS 2010, as cited in NewFields 2015). All participants had hair mercury levels that were within acceptable levels. Additionally, the communities that were downriver and closest to the former Red Devil Mine (Red Devil, Crooked Creek, and Chuathbaluk) had some of the lowest levels of the sampled communities.

Pre-existing Environmental Hazardous Materials. NewFields (2015) reported that blood lead levels in Alaskan children (less than 6 years old) had a lower rate (cases per 100,000) then the national rate of blood lead levels exceeding the CDC threshold of 5 micrograms per deciliter (µg/dL), which were 23 compared to 565 (out of 100,000 persons), respectively (ADHSS 2014, as cited in NewFields 2015).

There are a total of 15 open ADEC regulated contaminated sites, 4 U.S. Environmental Protection Agency (EPA) Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) sites, and 1 Formerly Used Defense site in the communities of Aniak, Lower Kalskag, Red Devil, Sleetmute, and Stony River (ADEC 2011, as cited in NewFields 2015). Exposure to potentially hazardous materials is shown in Table 3.22-7.

Table 3.22-7: Exposure to Potentially Hazardous Materials

Subject	Community (Bethel Census Area or as noted)	Regional (Y-K region or as noted)	Alaska	National
Hair Mercury Median for Tested Riverbank Communities (ppm)	Total: 0.510 Male: 0.768 Female: 0.557	--	Total: 0.46	--
Hair Mercury Range for Tested Riverbank Communities (ppm)	Total: 0.030-3.707 Male: 0.126-3.640 Female: 0.033-3.707	--	--	--
Children Elevated Blood Lead Level Case Rate	23	--	--	565

Notes:

Ppm = parts per million
-- = Not Available and/or Not Used

3.22.3.4.4 HEC 4: FOOD, NUTRITION, AND SUBSISTENCE ACTIVITY

It should be noted that subsistence activity is vital in the region, especially for small central Kuskokwim River communities, which is not represented in household income data and related food supply information. Refer to Section 3.21, Subsistence, for more information on subsistence activity.

Micronutrients Deficiencies. There are no clear signs of nutritional deficiencies in the Bethel Census area such as reports of scurvy or other nutritional disorders. Limited market data show a supermarket in Aniak and small stores throughout other communities stocked with basic food options (NewFields 2015). Subsistence foods are widely used (refer to Section 3.21 Subsistence) and are widely recognized as healthier than market food options.

Food Security. Food Security is defined by the WHO as “existing when all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life” (WHO 2011). Based on U.S. Department of Agriculture definitions, many of the small central Kuskokwim River communities are below total food security with some as low as 52 percent (Lower Kalskag) and all (except Aniak at 89 percent) were between 52 percent to 82 percent which were below the state and U.S. rate of 87 percent (ADF&G 2011, as cited in NewFields 2015). The small central Kuskokwim River communities also had worse rates for residents experiencing “low” (excluding Aniak (6 percent), ranging from 10 percent to 25 percent) and “very low” (0 to 22 percent) food security with some like Lower Kalskag (22 percent) being four times or more of the state (low food security of 8 percent and very low food security of 5 percent) and U.S. (low food security of 8 percent and very low food security of 5 percent) percentages (Brown et al. 2012, as cited in NewFields 2015). Food security data, as collected by ADF&G, do include subsistence foods as well as store-bought foods. However, it is not known what percent of residents’ food supply comes from subsistence activities (NewFields 2015).

Food Costs. A metric for comparing relative food costs is to compare the percent of the median household income to purchase the same food products annually. This comparison shows that, to get the same food, 9.2 percent of the household median income for Anchorage is equivalent to 24.0 percent of the median household income for the Bethel Census Area. At the community level, Bethel was 14.7 percent and rose to 53.6 percent for Upper Kalskag, and as high as 125.0 percent for Stony River (USCB 2000; ADOL&WD, ACS [2005-2009]; University of Fairbanks 2011, all as cited in NewFields 2015). Food, nutrition, and subsistence activity are shown in Table 3.22-8.

Table 3.22-8: Food, Nutrition, and Subsistence Activity

Subject	Community (Bethel Census Area or as noted)	Regional (Y-K region or as noted)	Alaska	National
Total Food Security (percent)	Lower Kalskag: 52% Aniak: 89% Other Central Kuskokwim River Communities range from 69% to 82%	--	87%	87%
Low Food Security (percent)	Lower Kalskag: 25% Aniak: 6% Other Central Kuskokwim River Communities range from 10% to 22%	--	8%	8%
Very low food Security (percent)	Lower Kalskag: 22% Aniak: 5% Other Central Kuskokwim River Communities range from 0% to 13%	--	5%	5%
Foodbasket Costs (percent of income)	Bethel Census Area: 24.0% Bethel: 14.7% Upper Kalskag: 53.6% Stony River: 125.0%	Anchorage: 9.2%	--	--

Notes:

-- = Not Available and/or Not Used

3.22.3.4.5 HEC 5: INFECTIOUS DISEASES

The role of infectious diseases in the mortality and morbidity rates of a population is well known. Reportable infectious diseases (i.e., tuberculosis, septicemia, viral hepatitis, HIV, and sexually transmitted infections [STIs], influenza, and pneumonia) were the fifth leading cause of death to all races in the Bethel Census Area, but it should be noted that this was based on a low count of 16 infectious disease-related deaths from 2010 to 2012. More noteworthy are the conditions that promote the spread of disease such as unsafe water, poor personal hygiene, and unsanitary conditions which may be more common in rural regions (ADHSS undated; WHO 1999, both as cited in NewFields 2015).

STIs. STIs account for 89.4 percent of reported infectious disease cases from 2007 to 2008 for Alaska Natives with *Chlamydia trachomatis* being 10 times more common than the next STI of gonorrhea (University of Wisconsin 2011; ADHSS 2011, both as cited in NewFields 2015). In 2011, the chlamydia rate in the Bethel Census Area was 2,321 cases per 100,000 population compared to the state rate of 711 cases per 100,000 population with both rates increasing from previous years (University of Wisconsin 2011, as cited in NewFields 2015). Alaska Native men and women had higher rates, 4 and 7 times higher, respectively, than Alaska white men and women. In 2005, the gonorrhea rate for Alaska Natives within the YKHC service area (116 cases per 100,000 population) is higher than the state gonorrhea rate for all races (92 cases per 100,000 population), but is nearly equivalent to the national gonorrhea rate of 115.6 cases per 100,000 population (AN Epicenter 2007, as cited in NewFields 2015).

Immunization. There are mixed findings showing immunization rates. For Alaskan children in 2009, immunization rates were low at 56.6 percent which ranked 48th among all states; yet in the YKHC area, the rates in 2007 showed 90 percent had received their childhood immunizations which was higher than the national rate of 78.0 percent reported for the Indian health Service (ADHSS 2011; AN Epicenter 2007, both as cited in NewFields 2015). Infectious diseases are shown in Table 3.22-9 below.

Table 3.22-9: Infectious Diseases

Subject	Community (Bethel Census Area or as noted)	Regional (Y-K region or as noted)	Alaska	National
Ranking of Top Types of Reported Infectious Disease (percent)	STIs (89.4%) Hepatitis B &C (3.9%) Pneumococcal Invasive (2.6%) Tuberculosis, Pulmonary (1.0%)	--	--	--
Chlamydia Cases (rate per 100,000)	2,321	--	711	--
Gonorrhea Cases (rate per 100,000)	--	116 (AN)	92 (all races)	115.6 (all races)
Immunization Rate (percent)	--	90%	--	78.0 (Indian Health Service)

Notes:

AN = Alaska Native
-- = Not Available and/or Not Used

3.22.3.4.6 HEC 6: WATER AND SANITATION

Key preventable risk factors for the spread of infectious diseases are the lack of clean running water and proper sewage disposal which are prevalent in rural Alaska (NewFields 2015). As of 2008, the YKHC had water and sanitation service for 58 percent of their communities which was the fewest of the 14 regional health corporations. Although the YKHC was the largest corporation by far, with 4,760 housing units (the next highest had 2,329 units), their service rate was well below the 76 percent overall served for all corporations (AN Epicenter 2009, as cited in NewFields 2015). Of the eight small central Kuskokwim River communities, Crooked Creek, Red Devil, and Stony River lack any residential water and sewer services. The other communities are served by central wells and a mix of central sewage plumbing, septic systems, honey buckets, and outhouses. Smaller towns have community washeterias for laundry and bathing (NewFields 2015).

3.22.3.4.7 HEC 7: NON-COMMUNICABLE AND CHRONIC DISEASES

Non-communicable and chronic diseases consume a large part of healthcare resources and affect the overall health status of a population. Overall, the relative small population of the

Bethel Census Area makes calculating rates (per 100,000 people) for causes of death and disease unreliable and difficult to compare to state rates.

Cancer. In the Bethel Census Area, cancer accounts for 21.6 percent of all deaths and has been the leading cause of death for the previous decade and as recent as the 2007 to 2009 period. For this period, the leading causes of cancer deaths amongst Alaska Natives were lung cancer at 27 percent and then colon and rectum cancer at 13 percent. All others were 6 percent or less (AN Epicenter 2009, as cited in NewFields 2015).

For the period of 2010 to 2012, the total number of cancer deaths for the Bethel Census Area was 67 resulting in an age-adjusted rate of 235.2 (per 100,000) which was a higher rate than the state with a count of 2,736 and a rate of 169.9. During this period, lung cancer deaths led all other cancers with 19 occurrences (rate of 73.4 [age-adjusted rate per 100,000]), followed by 16 counts (rate of 44.8) of colon cancer deaths, and all others were 5 or less. For counts less than 20 occurrences, the calculated rates are not reliable, but age-adjusted rates for both would be higher than the state (lung [count of 763 and rate of 49.0] and colon [count of 249 and rate of 15.2]) (BVS 2014, as cited in NewFields 2015).

Cardiovascular, Stroke and Respiratory Diseases. Cardiovascular disease and chronic lower respiratory disease are noted leading causes of death for Alaska Natives. Tentatively calculated age-adjusted rates of death caused by major cardiovascular diseases (number of deaths per 100,000 U.S. year 2000 standard population) for the Bethel Census Area from 2010 to 2012 are higher than statewide rates, with the Bethel Census Area have an age-adjusted rate of 277.2 and Alaska having an age-adjusted rate of 196.4 (NewFields 2015, ADHSS as cited in NewFields 2015).

Chronic obstructive pulmonary disease (COPD) mortality data from 2008 to 2011 show Alaska Natives in the Y-K region had a COPD rate of 67.0 (count of 31) as compared to all Alaska Natives with a rate of 73.5 (count of 174). Both rates are higher than those reported for both Alaska Non-Natives (38.7) and U.S. whites (45.6) (AN Epicenter 2014, as cited in NewFields 2015).

Cerebrovascular disease or stroke deaths for the Bethel Census Area show a rate of 59.2 deaths per 100,000 people which is higher than the state rate of 40.6 (ADHSS 2007-2014, as cited in NewFields 2015). The Alaska Native rate for stroke cases has steadily increased since 1992 whereas the rate for the state has steadily decreased (AN Epicenter 2007, as cited in NewFields 2015).

Liver Disease. Chronic liver disease and cirrhosis are noted leading causes of death for the state but there were only five counts in 2010 to 2012 from the Bethel Census Area (BVS 2014, as cited in NewFields 2015).

Mental Health. Based on 2008 to 2010 self-reported Behavioral Risk Factor Surveillance System (BRFSS) data, the Bethel Census Area had fewer self-reported days of poor mental health than state averages (2.3 days compared to 2.8 days), and lower rates of mental distress (5.9 percent compared to 8.0 percent) (ADHSS 2009, as cited in NewFields 2015). The prevalence of poor mental health may be more common than reported, as evidenced by the high suicide rates for both the Bethel Census Area and the Yukon Koyukuk Census Area (Section 3.22.3.6.1).

Dietary Diseases. BRFSS and CDC data from 2004 to 2011 show Bethel Census Area with an obesity rate of 32 percent. Regional and state obesity rates for the period of 2005 to 2007 show the Alaska Natives of the Y-K region to be 26 percent, statewide Alaska Natives to be 31 percent, statewide Non-Natives to be 25 percent, and US all races to be 28 percent (ADHSS 2009; AN Epicenter 2009, CDC 2008, as cited in NewFields 2015).

Based on self-reported BRFSS data from 2008 to 2010, Bethel Census Area had 3.7 percent of adults with diabetes which is less than the state rate of 6.8 percent (ADHSS 2009 as cited in NewFields 2015).

Tobacco Use. In the Bethel Census Area, 34 percent of adults smoke, which is higher than the state rate of 23 percent (University of Wisconsin 2011, as cited in NewFields 2015). Alaska Native adults and adolescents are twice as likely to smoke as non-Natives with Alaska Native young men having the highest rates (AN Epicenter 2007, as cited in NewFields 2015).

Data from periods 2005 to 2007 and 2008 to 2010 show relatively high smokeless tobacco use in the Bethel Census Area with rates being five times higher than state rates, and Alaska Natives in the YKHC three times higher than Alaska Natives statewide. Similar trends are noted amongst Alaska Native high school students when compared to non-Native students (AN Epicenter 2007; ADHSS 2009, both as cited in NewFields 2015). Non-communicable and chronic diseases are shown in Table 3.22-10.

Table 3.22-10: Non-Communicable and Chronic Diseases

Subject	Community (Bethel Census Area or as noted)	Regional (Y-K region or as noted)	Alaska	National
Leading Cancer Deaths (count & rate)	Lung (count of 19 and rate of 73.4) Colon (count of 16 and rate of 44.8)	--	Lung (count of 763 and rate of 49.0) Colon (count of 249 and rate of 15.2)	--
Cardiovascular Disease Deaths (count & rate)	Count of 64 and rate of 277.2	--	Count of 2,841 and rate of 196.4	--
Chronic obstructive pulmonary disease (COPD) Mortality (rate)	--	AN: 67.0	AN: 73.5 Alaska Non-Natives: 38.7	White: 45.6
Cerebrovascular Mortality (rate)	59.2	--	40.6	--
Poor Mental Health Days per Month	2.3 days	--	2.8 days	
Obesity Rate (percent)	32% (all races)	26% (AN)	31% (AN) 25% (Non-Native)	28% (all races)
Smokers (percent)	34%	--	23%	--

Notes:

AN = Alaska Native
-- = Not Available and/or Not Used

3.22.3.4.8 HEC 8: HEALTH SERVICES INFRASTRUCTURE AND CAPACITY

An important measure of the health-related resilience and support structure of a community is the quality and quantity of healthcare that is available to the residents.

Health Services. The Alaska Native Medical Center (ANMC) is the statewide referral center for specialty care for Alaska Natives. Yukon Kuskokwim Delta Regional Hospital (YKDRH) is a 50-bed hospital located in Bethel that provides dental and optical services, mental health services, substance abuse counseling and treatment, health promotion and disease prevention programs, and environmental health service. The ANMC and YKDRH support a system of small local clinics throughout the region (YKHC undated, as cited in NewFields 2015).

Due to the remote region and terrain, air travel is the primary mode of large distance transportation, especially for medical issues. Flight times from the small central Kuskokwim River communities to the city of Bethel medical facilities range from 39 minutes (from Lower Kalskag) to about 1.5 hours (from Stony River) (YKHC 2014).

Hospitalizations. Based on regional hospital data in Bethel, the leading causes of inpatient days were alcohol abuse, psychoses, pneumonia, and childbirth. The primary reasons for outpatient visits included upper respiratory problems, hospital medical/surgical follow-up visits, and pregnancy, childbirth, and puerperium (a period of six weeks after childbirth) (AN Epicenter 2007, as cited in NewFields, 2013).

Health impact issues for the adequacy of health services for areas are Health Professional Shortage Area (HPSA) or a Medically Underserved Area/Population (MUA/P). These designations take into account the availability of medical care by population size and whether the care is over-utilized, excessively distant or otherwise inaccessible.

Primary Care HPSAs are based on a physician to population ratio of 1:3,500. In other words, when there are 3,500 or more people per primary care physician, an area is eligible to be designated as a primary care HPSA. Dental HPSAs are based on a dentist to population ratio of 1:5,000. Mental Health HPSAs are based on a psychiatrist to population ratio of 1:30,000. MUAs may be a whole county or a group of contiguous counties, a group of county or civil divisions or a group of urban census tracts in which residents have a shortage of personal health services. Medically Underserved Populations (MUPs) may include groups of persons who face economic, cultural or linguistic barriers to health care (HRSA 2015).

HPSAs may be designated as having a shortage of primary medical care, dental or mental health providers. They may be urban or rural areas, population groups, or medical or other public facilities (HRSA 2015).

It should be noted that these designations are most directly comparable when the populations are similar, otherwise a relatively low population area such as the Y-K census area may appear to have less “need” than a densely populated area when the difference may be more due to the population disparity than actual “need”. Also comparing a community to a larger region or state would not be meaningful since the region or state value represents a sum total that includes the community.

The Bethel Census Area is designated as MUA and the HPSA rating is 11. Figure 3.22-3 indicates health professional shortages by discipline in Alaska.

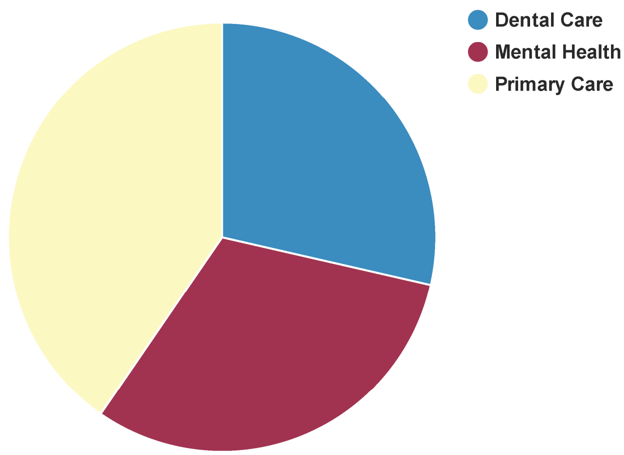


Figure 3.22-3: Health Professional Shortage Areas by Discipline - Alaska

3.22.3.5 TRANSPORTATION FACILITIES

The communities affected by the transportation facilities component are found along the route for the supply chain for the mine site. Baseline health conditions for these communities have already been described in Section 3.22.3.4 since they overlap with the Mine Site and Infrastructure component. Key project activities with potential health effects to the affected communities are Bethel Port (including the dock and fuel storage improvements), Kuskokwim River barge traffic, and the Angyaruaq (Jungjuk) Port site. Details on the project descriptions are presented in Chapter 2, Alternatives, and a summary of the potentially affected communities was presented above in Section 3.22.3. Section 3.22.3.3 presents the baseline data for the Bethel Census Area, YKHC Service area, and the small Kuskokwim River communities (as available) for all HECs.

3.22.3.6 NATURAL GAS PIPELINE

The natural gas pipeline includes rights-of-way (ROWs), above ground facilities (fault crossings, a compressor station, pig launcher and receiver station, and main line valves), and temporary work areas outside the ROW over mostly remote and rural regions except for the communities near the eastern terminal end which includes the KPB and MSB. Details are presented in the project description in Chapter 2, Alternatives, and a summary of the potentially affected communities was presented in Section 3.22.3.

Although the Y-K region is included under the potentially affected communities of the natural gas pipeline component, its data are generally not repeated here (except for context as applicable) since it has been covered under the mine site component. KPB and MSB are the potentially affected communities primarily covered in this section, as well as Alaska Natives in general, since they are a functional classification representing the small central Kuskokwim River communities.

3.22.3.6.1 HEC 1: SOCIAL DETERMINANTS OF HEALTH (SDH)

Minimal data specific to KPB and MSB were available for intimate partner violence, oral health, or family structure. Subsistence information is presented in Section 3.21, Subsistence, and additional data specific to Alaska Native populations are presented in Section 3.22.3.4.1.

Life Expectancy. For the Kenai region, the life expectancy of Alaska Native males and females in the period of 2000 to 2008 is 70.7 years and 71.5 years, respectively (ANTHC 2012). For the Anchorage and Mat-Su region, the life expectancy for Alaska Native males and females in the period of 2000 to 2008 are 66.6 years and 73.3 years, respectively (ANTHC 2011).

Maternal and Child Health. Approximately 37 percent fewer Alaska Native mothers received adequate prenatal care than white mothers in Alaska (ADHSS 2007-2014, as cited in NewFields 2015).

Infant mortality rates (per 1,000 live births) for the period of 2010 to 2012 in the KPB were 3.2, and in the MSB were 1.9. (BVS 2014, as cited in NewFields 2015) were relatively low as compared to the U.S. (6.75) (CDC 2010).

The percentage of babies born with low birth weight from 2010 to 2012 in the KPB (4.7 percent) and MSB (5.8 percent) is relatively low compared to the US (8.0 percent [2012]) (CDC 2014). Statistics for Alaska Native babies were slightly lower percentage of low birth weights in the KPB (7.8 percent) and in the MSB (6.6 percent). Teen birth rates for all races were 6.3 percent for the KPB and 7.9 percent with higher rates for Alaska Natives (12.2 percent and 13.5 percent, respectively) than Whites (5.4 percent and 7.1 percent, respectively). Although equivalent between KPB and MSB, the percentage of mothers who smoked during pregnancy in the KPB was 13.7 percent and in the MSB was 12.8 with Alaska Native mothers (25.7 percent and 23.4 percent, respectively) almost double than White mothers (11.9 percent and 11.5 percent, respectively) (BVS 2014, as cited in NewFields 2015).

Child abuse rates are not available specifically for the KPB and MSB. OCS groups the state into four vast regions which generally show rural locations have higher rates of child abuse than Anchorage or the Southeastern region in 2010 (OCS 2010, as cited in NewFields 2015).

Suicide. The suicide rates for the period of 2010 to 2012 for the KPB was 23.8 based on 46 deaths, the MSB was 15.2 based on 46 deaths, the Yukon-Koyukuk Census Area was 60.2 based on a low count of 14 deaths, and the Bethel Census Area was 17.6 based on 22 deaths. Based upon ranking for leading cause of death, Yukon-Koyukuk and Bethel Census Areas both ranked suicide as fourth, and KPB and MSB did not rank suicide in the top five (BVS 2014, as cited in NewFields 2015).

Median Household Income. Section 3.22.3.1 summarizes income data for the region. At the community level, amongst the high group were Beluga ($66,090) and McGrath ($66,111) and amongst the low group were Stony River ($6,667) and Crooked Creek ($10,391) (USCB undated, as cited in NewFields 2015).

Employment. Section 3.22.3.1 summarizes employment data for the region. At the community level, unemployment was highest at Nikolai at 24.2 percent, followed by Crooked Creek at 20.0 percent, and then Sleetmute at 11.8 percent (USCB undated, as cited in NewFields 2015).

Educational Attainment and Workforce Development. The high school dropout rate for the 2009-2010 school year based on NCES (2014) was higher than the US rate (7 percent) for the communities of Beluga (25 percent), Tyonek (25 percent), Susitna (9.2 percent), and Sleetmute (28.57). In contrast, the KPB and MSB had overall lower rates of 4.58 percent and 5.19 percent, respectively. Notably, Nikolai, McGrath, Takotna, and Stony River had a 0 percent dropout rate. Literacy rates were high (86 percent or better) for all reported regions (ADOL&WD, ACS, as cited in NewFields 2015). Relatively higher education rates (Bachelor's degree or higher) are recorded for Beluga (100 percent) and Susitna (72.7 percent) with Borough level rates for KPB (20.7 percent) and MSB (19.9 percent) near 20 percent for both (ADOL&WD, ACS2009, as cited by Newfield 2013). Social determinants of health are shown in Table 3.22-11.

Table 3.22-11: Social Determinants of Health

Subject	Community	Regional	Alaska	National
Life Expectancy (yrs)	--	Kenai region: 70.7 (AN male) 71.5 (AN female) Anchorage & Mat-Su: 66.6 (AN male) 73.3 (AN female)	--	--
Infant Mortality (rate per 1000 births)	--	KPB: 3.2 MSB: 1.9	--	6.75
Low Birth Weight (percent)	--	KPB: 4.7% (all races) 7.8% (AN) MSB: 5.8% (all races) 6.6% (AN)	--	8.0% (all races)
Teen Birth Rate (percent of all births)	--	KPB: 6.3% (all races) 12.2% (AN) 5.4% (White) MSB: 7.9% (all races) 13.5% (AN) 7.1 (White)	--	--
Pregnant Mothers Who Smoked (percent of births)	--	KPB: 13.7% (all races) 25.7% (AN) 11.9% (White) MSB: 12.8% (all races) 23.4% (AN) 11.5 (White)	15.5% (all races) 30% (AN) 10% (White)	--
Suicide Rate	--	KPB: 23.8 MSB: 15.2 Y-K CA: 60.2 Bethel CA: 17.6	--	--
Median Household Income	Beluga: $66,090 McGrath: $66,111 Stony River: $5,667 Crooked Creek:$10,391	KPB: $70,728 MSB: $59,421	--	--
Unemployment (percent)	Nikolai: 24.2% Crooked Creek: 20.0% Sleetmute: 11.8%	KPB: 5.6% MSB: 6.8%	--	--

Table 3.22-11: Social Determinants of Health

Subject	Community	Regional	Alaska	National
High School Dropout Rate	Beluga: 25% Tyonek: 25% Susitna: 9.2% Sleetmute: 28.57% Nikolai: 0% McGrath: 0% Takotna: 0% Stony River: 0%	KPB: 4.58% MSB: 5.19%	--	7%
Higher Education	Beluga: 100% Susitna: 72.7%	KPB: 20.7% MSB: 19.9%	--	--

Notes:

AN = Alaska Native
CA = census area
KPB = Kenai Peninsula Borough
MSB = Mat-Su Borough
-- = Not Available and/or Not Used
yrs = years

3.22.3.6.2 HEC 2: ACCIDENTS AND INJURIES

Fatal Injuries. Age-adjusted rate per 100,000 population accidental death rates from 2010 to 2012 for KPB (49.5), MSB (57.3), Y-K Census Area (176.0), and Bethel Census Area (82.1) were all higher than the state (49.2). Motor vehicle accidents and poisoning (includes alcohol poisoning) were noteworthy causes, but low regional population and low counts increased uncertainty (BVS 2014, as cited in NewFields 2015).

Non-fatal Injuries. Available data for 2010 indicate crude rates of non-fatal accidents per 10,000 population of Alaska Natives, to be lower in KPB and MSB (102.8, collectively), and Yukon-Koyukuk Census Area (99.7) to be lower than Alaska Native rates statewide (108.1) (Alaska Trauma Registry 2010, as cited in NewFields 2015).

Dry/Wet/Damp Community. Nikolai is a “dry” community and Red Devil is a “damp” community; the others allow sale and possession (AST 2012, as cited in NewFields 2015). Accidents and injuries are shown in Table 3.22-12.

Table 3.22-12: Accidents and Injuries

Subject	Community	Regional	Alaska	National
Death Rate from Accidents (rate)	--	KPB: 49.5 MSB: 57.3 Y-K CA: 176.0 Bethel CA: 82.1	49.2	--
Non-Fatal Accidents (rate per 10,000)	--	KPB & MSB: 102.8 (AN) Y-K Census Area: 99.7 (AN	108.1 (AN)	

Notes:

AN = Alaska Native KPB = Kenai Peninsula Borough MSB = Mat-Su Borough
-- = Not Available and/or Not Used

3.22.3.6.3 HEC 3: EXPOSURE TO POTENTIALLY HAZARDOUS MATERIALS

Existing Contaminated Sites. Within Tyonek, there are 18 open contaminated sites (mostly by oil and gas industries). At Skwentna there are four sites, and at McGrath there are 22, plus two large landfills, and an old sewer system (NewFields 2015).

3.22.3.6.4 HEC4: FOOD, NUTRITION, AND SUBSISTENCE ACTIVITY

It should be noted that subsistence activity is vital in the region, especially for the small rural communities, which is not represented in household income data and related food supply information. Refer to Section 3.21, Subsistence, for subsistence activity.

3.22.3.6.5 HEC 5: INFECTIOUS DISEASES

Infectious Diseases. The low counts make rates for infectious and parasitic disease caused deaths uncertain. For the period of 2010 to 2012, the KPB the age-adjusted rate per 100,000 population was 16.3 with the leading cause being septicemia (8.7) followed by viral hepatitis (2.7). For the MSB the rate was 10.7 with the leading cause being viral hepatitis (3.1) followed by septicemia (2.3). For pneumonia caused deaths, the rates for KPB and MSB were 10.4 and 10.1, respectively. (BVS 2014, as cited in NewFields 2015).

In 2010, the *Chlamydia trachomatis* rates (per 100,000 population) for all Alaskans in the KPB were 281, and in the MSB were 317, as compared to the state and US rates of 711 and 83 cases, respectively (BVS 2014, as cited in NewFields 2015). Infectious diseases are shown in Table 3.22-13.

Table 3.22-13: Infectious Diseases

Subject	Community	Regional	Alaska	National
Infectious Disease Deaths (rates per 100,000)	--	KPB: 16.3 MSB: 10.7	--	--
Pneumonia Caused Deaths (rate)	--	KPB: 10.4 MSB: 10.1	--	--
Chlamydia trachomatis (rate)	--	KPB: 281 MSB: 317	711	83

Notes:

-- = Not Available and/or Not Used
KPB = Kenai Peninsula Borough
MSB = Mat-Su Borough

3.22.3.6.6 HEC 6: WATER AND SANITATION

There are many part-time occupied houses (recreational and seasonal purposes) within the potentially affected communities. Some communities have less than 10 percent of all housing structures occupied full-time (i.e., Susitna, Skwentna). Most have individual wells, either outhouses or septic sewage systems, and either burn refuge or use local landfills; only McGrath has formal garbage service. Tyonek and McGrath have the most full-time occupied homes and facilities with 70 and 147, respectively; and most are fully plumbed with sewer service. Nikolai and Sleetmute have almost 40 full-time households. Beluga, Susitna, Skwentna, Takotna, and

Stony River have about 20 full-time households or less with mixed well or surface water sources and mixed outhouse or septic systems (NewFields 2015).

3.22.3.6.7 HEC 7: NON-COMMUNICABLE AND CHRONIC DISEASES

Smoking and substance abuse data are not readily available specifically for the KPB and MSB. Discussion on these topics for Alaska Natives is presented in Section 3.22.3.4.7

Cancer. Cancer was the leading cause of death in 2012 for all regions, with the KPB rate of 143.5 slightly lower and the MSB rate of 177.5 slightly higher the state rate of 163.3 (age-adjusted). The leading prevalent cancer types for the period of 2010 to 2012 were lung, breast, and then prostate. The KPB (lung [49.6], breast [24.7], prostate [24.4]) and MSB (lung [54.8], breast [21.0], prostate [23.0]) rates for these three cancer types were similar to the state (lung [49], breast [19.9], prostate [20.2]) (BVS 2014, as cited in NewFields 2015).

Heart Disease. From 2007 to 2009, heart disease ranked as the second most prevalent cause of death statewide (age adjusted rate of 155.9) as well as for the KPB (228.5) and the MSB (149.6) (ADHSS undated, as cited in NewFields 2015).

Diabetes. In 2009, the diabetes-related death rates were similar between the KPB (65.3), MSB (73.7), and the state (62.8) with KPB having slightly fewer deaths. Historically, the prevalence of diabetes has been growing through all regions within the state; and from 1990 to 2006; the Alaska Native rate increased 114 percent (ADHSS undated, as cited in NewFields 2015).

Chronic Lower Respiratory Disease. The KPB had 16 and the MSB had 22 deaths from chronic lower respiratory disease in 2012 which results in an age-adjusted rate similar to the state (25.4 and 54.6, respectively). In comparison, the COPD rate for the state was 40.1 in 2012 (BVS 2014, as cited in NewFields 2015).

Cerebrovascular Diseases. In 2012, both KPB (32.1) and MSB (33.6) had lower rates of stroke caused deaths than the state rate of 40.6. It should be noted that the rate for KPB was based on a low count of 15 deaths (ADHSS undated, as cited in NewFields 2015).

Chronic Liver Disease and Cirrhosis. In 2012, the KPB had higher lower chronic liver disease and cirrhosis death rate of 14.8 as compared to the state rate of 12.4, while the MSB had equivalent lower rate of 8.1 (BVS 2014, as cited in NewFields 2015).

Mental Health Disorders. Based on a self-reported survey, the KPB and MSB both recorded equivalent days of poor mental health compared to state (approximately 3 days per month) averages. The KPB (3.3 days) showed a slightly higher rate of frequent mental distress than both the MSB Borough (3.0 days) and the state (2.8 days) (BRFSS 2011, as cited in NewFields 2015).

Physical Activity. Based on self-surveyed reporting from 2008 to 2010, the KPB (76.7 percent) and MSB (64.2 percent) reported similar rates of physical activity as the state (79.0 percent) (BRFSS 2011, as cited in NewFields 2015). A 2009 study showed similar findings across the region and a general observation that Alaska Natives showed a greater percentage of those meeting physical activity recommendations than the U.S. rate (AN Epicenter 2009, as cited in NewFields 2015).

Obesity and Overweight. In 2010, the KPB (30 percent) and MSB (28 percent) were reported as having an equivalent percent of obesity as the state (28 percent) (University of Wisconsin 2011, as cited in NewFields 2015). Non-communicable and chronic diseases are shown in Table 3.22-14.

Table 3.22-14: Non-Communicable and Chronic Diseases

Subject	Community	Regional	Alaska	National
Cancer Death (rates)	--	KPB: 143.5 MSB: 177.5	163.3	--
Lung Cancer Prevalence (rate)	--	KPB: 49.6 MSB: 54.8	49	--
Breast Cancer Prevalence (rate)	--	KPB: 24.7 MSB: 21.0	19.9	--
Prostate Cancer Prevalence (rate)	--	KPB: 24.4 MSB: 23.0	20.2	--
Heart Disease (rate per 100,000)	KPB: 228.5 MSB: 149.6	--	155.9	--
Diabetes Deaths (rate per 100,000)	KPB: 65.3 MSB: 73.7		62.8	--
Diabetes Prevalence Increase by Percentage	--	Anchorage Area: 76% (AN)	114% (AN)	--
Chronic Lower Respiratory Disease Deaths (rate)	--	KPB: 25.4 MSB: 54.6	40.1	--
Cerebrovascular Disease Deaths (rate)	--	KPB: 32.1 MSB: 33.6	40.6	--
Chronic Liver Disease and Cirrhosis Deaths (rate)	--	KPB: 14.8 MSB: 8.1	12.4	--
Mental Health Disorders (reported days per month)	KPB: 3.3 MSB: 3.0	--	2.8	--
Physical Activity (percent of residents)	KPB: 76.7% MSB: 64.2%	--	79.0%	--
Obesity (percent of residents)	KPB: 30% MSB: 28%	--	28%	--

Notes:

AN = Alaska Native
-- = Not Available and/or Not Used
KPB = Kenai Peninsula Borough
MSB = Mat-Su Borough

3.22.3.6.8 HEC 8: HEALTH SERVICES INFRASTRUCTURE AND CAPACITY

The Fairbanks Memorial Hospital (110 workers) serves 35 villages of the interior including Nikolai, McGrath, and Takotna. Services include pharmaceutical, patient education, medical records, nutrition services, and social outreach services. The McGrath Health Center is a sub-regional Emergency Care Center clinic and supports the 50 Community Health Aides and Practitioners in the area. Central Kenai Peninsula Hospital and the Dena'ina Health Clinic serve the KPB. There is a lack of medical services for Beluga, Susitna, Skwentna, and Red Devil (NewFields 2015).

The KPB and MSB are designated as MUA with the KPB with a HPSA rating of 15 and the MSB with a HPSA rating of 14. Figure 3.22-3 displays health professional shortage areas by discipline in Alaska (HRSA 2015).

3.22.3.7 CLIMATE CHANGE

Climate change effects on the atmosphere, water resources, permafrost, vegetation, wildlife, and subsistence may have ramifications for several health determinants in the EIS Analysis Area. Climate change has likely contributed to recent declines in moose in GMU 19A and Chinook salmon populations in the Kuskokwim River. These declines threaten food security and nutrition, particularly in rural communities where subsistence harvests are important to the local food supply. Different hydrology patterns may affect drinking water quantity or quality, and different vegetative communities and bloom timing could increase allergens. Fire smoke pollution from more intense summer wildfires could also lower air quality seasonally. Indirectly, erosion or ground subsidence induced by permafrost melt may damage community sanitation facilities, which could spread infectious diseases or have other adverse health impacts. Stress caused by worries and adaptations for climate change may also indirectly have an adverse impact to rates of non-communicable and chronic health conditions.

Health categories, including food safety, air quality, and community water, are categories monitored in the ANTHC Local Environmental Observer Network. In 2014, observations were recorded for early willow budding in Bethel and transportation safety concerns related to thin ice on the Kuskokwim River. Accidents and injuries could result from potential increased dangers of winter travel over frozen waterways.

3.22.3.8 SUMMARY

The potentially affected communities of the EIS Analysis Area range in size from villages as small as 20 homes to relatively large population centers such as Bethel and the MSB. The ethnic composition and demography of the EIS Analysis Area also varies, ranging from majority Alaska Native to majority white populations. Given the broad population in the EIS Analysis Area, the baseline health status also varies across the different geographies and ranges from worse than the state average to equivalent with the state average. While the communities potentially affected by the mine site of the Y-K region and Bethel Census tracts typically fare worse than the state average in many aspects of physical, mental, and social health, there are also important health strengths. There are high rates of childhood immunizations in the YKHC service area, no clear signs of nutritional deficiencies in the Bethel Census Area, and residents report leisure time participation in physical activities. Rates of low birth weight infants, alcohol use by pregnant mothers, and divorce rates were lower than state averages. Dutch Harbor has lower rates of unemployment than the state average. While much of the region is classified as medically underserved or has a shortage of health care professionals, the larger communities, such as Bethel, the MSB, and the KPB, are serviced by a more extensive network of healthcare facilities.

3.22.4 ENVIRONMENTAL CONSEQUENCES

The potential consequences to human health were evaluated using criteria outlined in Alaska's HIA guidance (ADHSS 2011, 2015). The process was used for each health impact issue within each HEC. The impact dimensions first evaluate severity of potential health effects and an assessment of beneficial or adverse, and need for intervention if an adverse impact (Table 3.22-15). Other criteria are also used, similar to those evaluated for other resources including magnitude, duration, and extent. However, the terminology is unique to this section to maintain consistency with the ADHSS analysis criteria. For example, rather than duration of temporary, long-term, or permanent, all criteria are rated as low, medium, or high. While different from the terminology in other sections, the analysis and impact ratings for human health are consistent with the principles of analysis required by NEPA.

The process then evaluates the severity and likelihood of each type of impact and develops a summary impact rating of low, medium, high, or very high (Table 3.22-16). Again, this terminology is consistent with ADHSS terminology for health impact assessments. It is similar to the rating system for the rest of the EIS, but this summary impact rating terminology is used only in this section. While not evaluated within the ADHSS framework, the health context for this project is considered unique because communities in the EIS Analysis Area qualify as minority and / or low-income, as described in Section 3.19, Environmental Justice.

While the framework used for the evaluation of health impacts is generally consistent with ADHHS guidance, it is important to note that any assessment of potential impacts is subject to several types of uncertainty as summarized below. The data are considered sufficient for analysis in the EIS.

- Baseline data used to describe current health status and conditions varies along the spatial and temporal scales; the reported data may range from current to several years since data were collected; some data are available at the level of individual communities while others are regional or state-level in scale. Therefore, not all health conditions are described or evaluated at the same level of precision and timeliness. This uncertainty is described for each type of cited data.
- The evaluation of social determinants of health is particularly subject to uncertainty since many of the choices that affect social and mental health and behavioral risk factors are actually made at the level of the individual. Two individuals exposed to the same situation may make very different behavioral choices. Thus, there is uncertainty in trying to predict the aggregate of individual choices at a community level in terms of overall severity, likelihood and impact rating. The evaluation uses published literature, where feasible, to provide context for this type of uncertainty.
- Health consequences related to changes in environmental conditions, e.g., air quality, water quality, bioaccumulation in foods, are subject to modeling uncertainties. While the concentrations of chemicals under baseline conditions may be known, future concentrations (e.g., as related to end-of-mine life, post-closure) are estimated by using intentionally conservative modeling approaches. This approach is likely to overestimate the consequences of potential exposure to hazardous substances and is consistent with accepted regulatory approaches to evaluate chemical exposures.
- Some potential health consequences, by their very nature, are epidemiological, and not easily quantifiable. For example, effects related to communicable and non-communicable diseases typically cannot be quantified since their prevalence depends on numerous environmental, behavioral, and genetic factors. The potential for these indirect health effects to occur is included in the assessment based on reports of their occurrence at other projects and sites, but the severity and likelihood of their occurrence in relation to this project cannot be precisely estimated.
- Where quantifiable evaluations are not possible, qualitative evaluations strive for transparency in professional judgement. To this end, the components of the severity ranking system and the likelihood ranking system follow the gradations described in the

ADHHS guidance, and the final impact ratings are based on a combination of severity and likelihood considerations. This allows the reader to clearly understand the basis of the ratings for project-related health consequences.

Table 3.22-15: Impact Dimensions

Step 1				
Impact Dimensions				
Impact Rating Score	**A – Health Effect (+/-)**	**B- Duration**	**C-Magnitude**	**D- Extent**
0 - Low	Effect is not perceptible	Less than 1 month	Minor	Individual cases
1 - Medium	(+/-) minor benefits or risks to injury or illness patterns (no intervention needed)	Temporary: 1-12 months	Those impacted will 1.)be able to adapt to the impact with ease and maintain pre- impact level of health, 2.) see noticeable but limited and localized improvements to health conditions	Local: small limited impact to households
2 - High	(+/-) moderate benefits or risks to illness or injury patterns (intervention needed, if negative)	Medium-term: 1 to 6 years	Those impacted will: 1.) be able to adapt to the health impact with some difficulty and will maintain pre-impact level of health with support, or 2.) experience beneficial impacts to health for specific population some maintenance may still be required	Entire Potentially Affected Communities; village level
3 – Very High	(+/-) severe benefits or risks: marked change in mortality and morbidity patterns (intervention needed, if negative)	Long-term: more than 6 years/life of project and beyond	Those impacted will 1.) not be able to adapt to the health impact or to maintain pre-impact level of health 2.)see noticeable major improvements in health and overall quality of life	Extends beyond Potentially Affected Communities; regional and state-wide levels

Source: ADHSS 2011, 2015.

Table 3.22-16: Likelihood Rating and Overall Impact Rating

Step 2	Step 3						
Impact Level (Use Score from Step 1 to choose range)	Likelihood Rating						
	Extremely Unlikely (<1%)	Very Unlikely (1-10%)	Unlikely (10-33%)	About as likely as Not (33-66%)	Likely (66-90%)	Very Likely (90-99%)	Virtually Certain (>99%)
1-3	♦	♦	♦	♦	♦♦	♦♦	♦♦
4-6	♦	♦	♦	♦♦	♦♦	♦♦	♦♦♦
7-9	♦♦	♦♦	♦♦	♦♦♦	♦♦♦	♦♦♦	♦♦♦♦
10-12	♦♦♦	♦♦♦	♦♦♦	♦♦♦♦	♦♦♦♦	♦♦♦♦	♦♦♦♦
Step 4	Impact Rating						
	Low= ♦ Medium= ♦♦ High = ♦♦♦ Very High = ♦♦♦♦						

Source: ADHSS 2011, 2015.

The ADHSS (2015) defines health as "the reduction in mortality, morbidity and disability due to detectable disease or disorder and an increase in the perceived level of health." Since health is a multi-dimensional concept with physical, mental, and social aspects, the project may affect aspects of health at a localized or individual level, a community level, a regional level, or a state-wide level.

For each alternative, the consequences of the project activities are described with regard to relevant issues and concerns associated with the eight HECs described in the HIA guidance (ADHSS 2015). The consequences to human health are considered for all project phases (construction, operations, and closure). While all project components were considered (mine site, transportation facilities, and pipeline), at times the project was analyzed as a whole because effects could not be attributed to a single component. Finally, the health consequences are summarized by HEC and for the alternative as a whole and expressed as low, medium, high or very high.

The HIA for this project is still under development by ADHSS and its contractors.

3.22.4.1 ALTERNATIVE 1 – NO ACTION

Under the No Action Alternative, the Donlin Gold Project would not occur; Donlin Gold would not develop a mine site, transportation facilities, or natural gas pipeline. Exploration activities would likely cease under Alternative 1, but there would not be a complete removal of infrastructure. The camp and airstrip are expected to remain in place. Socioeconomic impacts from Donlin Gold exploration activities, which were realized in the Y-K region over the previous decade, would cease. Human health impacts associated with the loss of jobs and decrease in household income would be low, with potential increases or decreases in social determinants of health, such as income, psychosocial stress, substance abuse, and family stability. Other health factors would return to pre-project levels, such as exposure to accidents, injuries, diseases, and potentially hazardous materials would cease. Health effects would be low to medium, effects not perceptible or minor benefits/risks to health, but no intervention needed. The duration would likely be up to 6 years, as the project proponents would likely continue to seek avenues to project development. The magnitude would be medium, with those affected able to adapt and return to pre-impact levels of health. The extent is considered medium / local, with impacts limited to households affected by exploration employment.

Therefore, Alternative 1 would have low direct or indirect effects, largely returning to pre-impact levels of health. There would be no contribution to cumulative effects on human health. Current health conditions and trends, as described in Affected Environment (Section 3.22.3), would continue in the EIS Analysis Area. Alternative 1 would have no effect on climate change as related to human health in the EIS Analysis Area. Existing trends in climate change, as described in Section 3.26, would continue.

3.22.4.2 ALTERNATIVE 2 – DONLIN GOLD'S PROPOSED ACTION

The communities potentially affected by the project range from small, remote, rural communities to larger regional and urban centers. The closest community is Crooked Creek, located approximately 10 miles southeast of the mine site. The communities within the Y-K region, including the Bethel Census Area and the Kusilvak Census Area, would be most closely affected by the mine site and the pipeline components, with Bethel and the Kuskokwim River communities also experiencing effects from the transportation component. Some regional centers, such as the KPB and MSB would be primarily affected by the pipeline component. Anchorage would be potentially affected by all components of the proposed project (Tables 3.18-1 and 3.18-2, in Section 3.18, Socioeconomics).

The consequences (described below) for all project components are expected to be more noticeable in the smaller communities and less perceptible in the larger communities of Bethel, Unalaska, the MSB, and the Municipality of Anchorage.

3.22.4.2.1 HEC 1: SOCIAL DETERMINANTS OF HEALTH

The following subsections present the evaluation of potential health impacts, both beneficial (positive) and adverse (negative), that are often correlated with social health determinants, including household incomes, employment and education attainment, psychosocial stress and mental health, substance abuse (including drugs and alcohol), and family stress and instability. Table 3.22-1 summarizes the potential impact levels for the social determinants of health, including the health effect consequence, magnitude (intensity), duration, and geographic extent of the impact, and likelihood of the impact occurring.

<u>Household Incomes, Employment, and Education Attainment</u>

Increases in household incomes, employment rates, and education attainment could result in an improvement to the overall health and well-being of residents living in the communities from which the workforce for the mine, transportation facilities, and natural gas pipeline would be employed. As noted in Section 3.18, Socioeconomics, the proposed project is expected to result in employment for about 1,600-1,900 people from among the local potentially affected communities during the construction phase, about 500-600 people during the operations phase, and 20-100 people during closure and reclamation.

The benefits (positive impacts) of these employment opportunities would be felt most in the households of those employees, but the ancillary sales and taxes would benefit the communities as a whole. However, it cannot be assumed that all of the increased income and ancillary sales and taxes would be directed towards increased healthcare spending or community healthcare facilities development. Therefore, although the economic benefit to the region may be major, the associated health benefits are rated as medium. The benefits are also expected to be more apparent in the small, remote, Kuskokwim River communities, where even small changes in their economies could have a measurable impact on their overall health and well-being. Most of the Kuskokwim River communities' economies are based on subsistence and have limited opportunities for long-term, stable employment (Section 3.18, Socioeconomics). The potentially affected communities also have high minority (Alaska Natives) and low-income populations (Section 3.22.3.1). It is estimated that about 14-18 percent of the residents living in the potentially affected communities do not have a high school diploma (Section 3.22.3.1). Increases in economic opportunities could result in an increase in the number of individuals in the potentially affected communities investing in their education, resulting in positive behavioral changes that could improve health. The potential health benefits of increased economic opportunities due to the proposed project could extend beyond the direct operating workforce because Alaska firms based in Anchorage would likely provide goods and services during the construction and operations and maintenance phases of the project (Section 3.18, Socioeconomics). While there would be employees from outside the region, Donlin Gold is committed to local hire.

The summary impact to human health due to increased household incomes, employment rates, and education attainment for the potentially affected communities would be medium (beneficial) for all three phases (i.e., construction, operations and maintenance, and closure, reclamation, and monitoring).

For all project phases, the health effect is anticipated to be medium (i.e., effect is perceptible), and the intensity of effect would be medium (measureable / noticeable change) since the benefits may be noticeable in terms of being able to afford increased and faster access to and utilization of healthcare (e.g., more visits to healthcare providers, increased use of treatment options). The geographic extent of this potential benefit would be medium because it would be realized by households and communities throughout the EIS Analysis Area that would benefit from project-related economic opportunities, which may range from 20 to 1,900 households (households associated with the expected employment opportunities) in the EIS Analysis Area, during the various project phases. These households are expected to be drawn from the potentially affected communities described in Section 3.22.3, primarily the communities of the Bethel Census Area, YKHC Service Area, and the small communities along the Kuskokwim River. However, the health benefits may extend to a state-wide level, depending on the overall distribution of economic benefits due to mine activities. The duration of this benefit would correlate with the duration of the three project phases; therefore, the construction phase (3-4 years) is rated high, and the operations and maintenance (27 years), and closure, reclamation, and monitoring (> 50 years) phases are rated very high. The likelihood of this benefit occurring is considered likely (66-90 percent) because Donlin Gold has established an in-region, Calista and TKC shareholder hiring preference and has committed to maintaining this hiring preference through the project phases.

Psychosocial Stress

There may be both decreases and increases in psychosocial stress, with different potential causes and effects in different segments of the community. The potential for decreases in psychosocial stress could occur due to improved economic opportunities. The available baseline data suggest rates of poor mental health for the potentially affected communities are low (ADHSS 2009, as cited in NewFields 2015). However, the prevalence of poor mental health may be more common than indicated, based on the high suicide rates for the Bethel Census Area and Yukon-Koyukuk Census Area (Section 3.22.3.6.1). The potential impacts of existing psychosocial stressors in the potentially affected communities such as high unemployment, low income, low education attainment, outward population migration, and rural isolation could be lessened by the perceived potential for increased economic opportunities. The improved economic status of residents in the potentially affected communities could result in improved mental health, but the positive effects may not be immediately discernable and possibly may be difficult to quantify.

There is also the potential for increases in psychosocial stress in the potentially affected communities, related to fear of changes in lifestyle and cultural practices, land encroachment, impact to natural resources (e.g., soil, air, groundwater, and surface water), and food security and quality. The addition of new stressors to the populations in the EIS Analysis Area could potentially worsen existing mental health conditions, primarily for those individuals that are susceptible and who are not benefiting from increased economic security related to the proposed project or accessory economic development. Community members in attendance at Donlin Gold Project public meetings had concern for potential impacts on mental health (NewFields 2015).

The summary impact to human health due to changes in psychosocial stress for the potentially affected communities would be medium (beneficial and adverse) for the construction and operations and maintenance phases, but low for the closure, reclamation, and monitoring phase.

The health effect would be medium, with beneficial and adverse effects. No intervention would be required for beneficial effects, and adverse effects could be considered minor injury that may not require intervention. The intensity of the impact would be medium (those impacted would be able to adapt easily). The geographic extent of this potential benefit would be medium with effects realized by communities throughout the EIS Analysis Area, primarily those reaping economic benefits and security.

The duration of impacts (adverse and beneficial) would be high for the construction phase (3-4 years) and very high for the operations and maintenance (27 years) and closure, reclamation, and monitoring (> 50 years) phases. The likelihood of effects is considered as likely as not (33-66 percent) during the construction and operations phases, but less likely (1-10 percent) during the closure phase. It is uncertain whether increased and/or stable incomes would promote positive behaviors in a substantial portion of the populations in the EIS Analysis Area. It is possible that stakeholders in the region would not display anxiety or stress due to the proposed project.

Rates of Substance Abuse

As with psychosocial stress, there may be both decreases and increases in rates of substance abuse, with different potential causes and effects in different segments of the community. Increases in substance abuse (drug and alcohol consumption) rates could result in negative health impacts such as alcohol poisoning, alcohol-related accidents and injuries, and drug addiction. Baseline data suggest high rates of substance abuse (especially binge drinking amongst males), alcohol poisoning, and alcohol related-accidents and injuries (University of

Wisconsin 2011, as cited in NewFields 2015). From 2004 to 2008, alcohol use was documented in 34.8 percent of all non-fatal injury cases in the Y-K region (NewFields 2015).

Alcohol abuse is also associated with the other leading causes of death (i.e., motor vehicle accidents, suicide, assault, and drowning) (NewFields 2015). Alaska Native villages have enacted policies that designate a community as dry (no sale or consumption), damp (no sale, but possession allowed), and wet (sale, importation, and possession allowed) to try to manage and mitigate this issue. As of June 2011, several communities in the EIS Analysis Area for the pipeline component have adopted "local option laws" to regulate alcohol. For instance, Nikolai has banned the sale, importation, and possession of alcohol and Red Devil has banned the sale of alcohol. Alcohol is permitted in some of the other communities in the EIS Analysis Area (ADPS, ABC Board 2011, as cited in NewFields 2015).

In other places where a number of people have been employed at past and present mine sites, the increase in disposable income led to noticeable increases in drug and alcohol use and gambling in the local communities (Diavik 1999; UBC 2014). Community members brought concerns to Donlin Gold Project stakeholder meetings for potential increases in alcoholism with increased income. [The group mentioned that this trend has been observed with other increases in income like the Permanent Fund Dividend (PFD) or 1-2 week jobs that fund an alcohol binge (NewFields 2015).] There were also community member concerns for drug use, particularly marijuana, and potential population influxes could influence problems related to drug and alcohol use (NewFields 2015).

Potential decreases in rates of substance abuse could also occur, due to the increase in jobs available in the region. Village and regional leaders have asserted the new jobs and increased income would increase family stability and decrease rates of substance abuse. Proportions of adverse and beneficial effects cannot be predicted, as the causes and effects would vary among different portions of the population.

> *I think it [employment] could be positive or negative. Certainly, if you have more money in your home and you are using it wisely you are in way better shape and a lot of those bad effects don't necessarily happen. As Evelyn Thomas up in Crooked Creek always pushes, when they had money a lot of the problems went away. Certainly a lot of problems can suddenly occur when you have money too. I don't know. That is one that would have to be carefully measured. I don't know which way it will go. But certainly improving the economic conditions out here would have to be a major benefit. The one that I hadn't anticipated which has been mentioned is that because the men were gone for long periods of time, they claim that divorce rates went way up. That might not be measurable because I have a feeling, that doesn't necessarily mean divorce. I think that also means there is a lot of people who aren't married out here but have a stable relationship. I have a feeling there are just a lot of men who moved on elsewhere. That is really bad for those left behind. On the behavioral health side that is a real problem.* (Regional Leader, Bethel) (Joseph Klejka, M.D., Medical Director YKHC, Bethel, AECOM Forthcoming).

The health effect, both beneficial and adverse, would be medium (minor benefits or minor injury that may not require intervention) and the intensity of the impact would be low. The geographic extent of this potential impact would be medium because a limited number of households would be affected (i.e., not every individual or every household within the affected area communities would be expected to exhibit such behavior). The duration of this impact would be high for the construction phase (3-4 years) and very high for the operations and maintenance (27 years) and closure, reclamation, and monitoring (> 50 years) phases. The likelihood of this impact occurring is considered as likely as not (33-66 percent) for all phases because it is uncertain whether increased and/or stable incomes would promote negative behaviors in a substantial portion of the populations in the potentially affected communities and whether these trends would lessen or increase when the economic changes associated with the closure phase occur. The summary impact to human health due to increased substance abuse rates would be medium (beneficial and adverse) for all project phases.

Family Stress and Instability

As with psychosocial stress and rates of substance abuse, there may be both decreases and increases in family stress and instability, with different potential causes and effects in different segments of the community. Increases in family stress and instability could occur due to fly-in, fly-out work rotations. Community interviews for other mine projects suggest that long-term fly-in, fly-out work rotations can contribute to stress and instability in families. Rotational work schedules can also affect relationships, and may increase feelings of fatigue, anxiety, worry, and jealousy, contributing to domestic violence, extra-marital affairs, and unwanted sexual harassment particularly of women (UBC 2014; Diavik 1999). Women reported an increase in spousal assaults as a result of mine employment and long-distance commuting, as well as noticeable strains on marriages and relationships (Diavik 1999). Some women reported excessive drinking and anger in some spouses when they returned from their mine rotation (UBC 2014). The rotation schedules and long absences also led to more disruptive behavior in children and reported difficulties in managing older children when the a parent was away (Diavik 1999). In several communities, additional stress was noted for extended family members (such as grandparents) who provided child care while a parent was away working at the mines (UBC 2014; Diavik 1999). Community members attending scoping meetings for the Donlin Gold Project indicated concerns for potential increases in marital problems, divorce, and family disruption because of long stays at the work camp and isolation with a rotational works schedule (NewFields 2015).

Potential increases in family stability could also occur, due to the increase in jobs available in the region. As noted in the discussion of rates of substance abuse, village and regional leaders have asserted the new jobs and increased income could improve family stability. Proportions of adverse and beneficial effects cannot be predicted, as the causes and effects would vary among different portions of the population.

The health effect would be medium (minor benefit or minor injury that may not require intervention) and the intensity of the impact would be low. The geographic extent of this potential impact would be local with a limited number of affected households (i.e., only a limited number of individuals within the affected communities would be likely to exhibit such behavior with corresponding effects on their households). The duration of this impact would be high for the construction phase (3-4 years) and very high for the operations and maintenance (27 years) and closure, reclamation, and monitoring (> 50 years) phases. The likelihood of this heath impact occurring is considered as likely as not (33-66 percent) because not all families in the potentially affected communities would be expected to exhibit symptoms of stress or instability. The summary impact to human health due to increased family stress for the potentially affected communities would be medium (beneficial and adverse) for all project phases.

Alternative 2, HEC 1 Impact Summary: Social Determinants of Health

For the social determinants of health, both beneficial and adverse (positive and negative) health impacts were evaluated. There could be potential beneficial increases in economic opportunities reductions in psychosocial stress, reductions in substance abuse, and improved family stability. Adverse health impacts could include potential increases in psychosocial stress, substance abuse rates, and family instability. The overall impact for HEC 1: Social Determinants of Health is rated as medium, as shown in Table 3.22-17, with both beneficial and adverse impacts under Alternative 2.

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Table 3.22-17: Summary of HEC 1 Impacts: Social Determinants of Health

Potential Impact	Project Component	Project Phase	Negative/ Positive	Health Effect	Magnitude/ Intensity	Duration	Geographic Extent	Severity Ranking	Likelihood Rating	Impact Rating	Impact Level
Increase in household incomes, employment, and education attainment	All components: Mine Site, Transportation Facilities, Natural Gas Pipeline	Construction	+	Medium (1)	Medium (1)	High (2)	Medium (1), limited to households that benefit from economic opportunities	**5**	66-90%	**	**Medium**
		Operations and Maintenance		Medium (1)	Medium (1)	Very high (3)	Medium (1), limited to households that benefit from economic opportunities	**6**	66-90%	**	**Medium**
		Closure, Reclamation, and Monitoring		Medium (1)	Medium (1)	Very high (3)	Medium (1), limited to households that benefit from economic opportunities	**6**	66-90%	**	**Medium**
Psychosocial stress	All components: Mine Site, Transportation Facilities, Natural Gas Pipeline	Construction	+/-	Medium (1)	Medium (1)	High (2)	Medium (1), limited number of households	**5**	33-66%	**	**Medium**
		Operations and Maintenance		Medium (1)	Medium (1)	Very high (3)	Medium (1), limited number of households	**6**	33-66%	**	**Medium**
		Closure, Reclamation, and Monitoring		Medium (1)	Low (0)	Very high (3)	Medium (1), limited number of households	**5**	1-10%	*	**Low**
Increase in substance abuse (including drug and alcohol)	All components: Mine Site, Transportation Facilities, Natural Gas Pipeline	Construction	+/_	Medium (1)	Low (0)	High (2)	Medium (1), limited number of households	**4**	33-66%	**	**Medium**
		Operations and Maintenance		Medium (1)	Low (0)	Very high (3)	Medium (1), limited number of households	**5**	33-66%	**	**Medium**
		Closure, Reclamation, and Monitoring		Medium (1)	Low (0)	Very high (3)	Medium (1), limited number of households	**5**	33-66%	**	**Medium**
Increase in family stress and instability	All components: Mine Site, Transportation Facilities, Natural Gas Pipeline	Construction	+/_	Medium (1)	Low (0)	High (2)	Medium (1), limited number of households	**4**	33-66%	**	**Medium**
		Operations and Maintenance		Medium (1)	Low (0)	Very high (3)	Medium (1), limited number of households	**5**	33-66%	**	**Medium**
		Closure, Reclamation, and Monitoring		Medium (1)	Low (0)	Very high (3)	Medium (1), limited number of households	**5**	33-66%	**	**Medium**

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3.22.4.2.2 HEC 2: ACCIDENTS AND INJURIES

Accidents (e.g., motor vehicle crashes, falls, and fires) can result in unintentional injuries. Intentional injuries include homicide and suicide. Non-fatal and fatal intentional and unintentional injuries can place a substantial burden on available healthcare resources (such as hospitals, clinics, and ambulances). The following subsections present the evaluation of potential impacts due to increases in unintentional accidents (air, surface, and water transportation) and intentional injuries (poisonings and suicides). Table 3.22-18 summarizes the potential impact levels for accidents and injuries, including the potential health effect consequence, magnitude (intensity), duration, and geographic extent of the impact, and likelihood of the impact occurring.

It is important to note Donlin Gold would provide safety training for all employees, health and safety plans would be developed and implemented, and public access would be prohibited in industrial facilities. The accidents and injuries discussed in this section are generally considered to be events with low probability of occurrence, but high consequence if they did occur.

Unintentional Accidents and Injuries Morbidity and Mortality Rates due to Air Transportation

Increases in accidents and injuries (mortality and morbidity rates) due to air transportation could occur because the primary mode of transportation for employees, time-sensitive supplies, and equipment for the project would be via air. Air transportation is also the primary mode of transporting mail and important goods, healthcare access, and residents’ routine travel within the region. Although air travel accidents occur very rarely, they have a high consequence, resulting in loss of life or severe health injuries.

Mine site employees would use a fly-in/fly-out work arrangement, with Donlin Gold organizing and paying for transportation between point of hire locations (such as Anchorage and Bethel) and the various project work sites. Local air traffic would increase by 5,148 annual operations during the construction phase, but would be reduced for the operations and maintenance phase (1,716 annual operations), and further reduced for the closure phase. Even though the project would result in an increase in air travel in the region, the Donlin Gold mine site airstrip would not be routinely used by the general public (except for emergencies) and, as such, would not directly impact air travel for residents living in the EIS Analysis Area. However, the increase in frequency of air travel due to the project, particularly for the construction phase, could affect the intensity of travel for the workforce (e.g., fly-in/fly-out rotations) and the potential for air travel accidents, indirectly affecting residents living in the EIS Analysis Area.

The workforce for the natural gas pipeline component would also be transported via air. Pipeline construction would require temporary airfields that would be reclaimed after the construction phase as well as use of existing public airports. Air traffic related to the natural gas pipeline component would be greatest during construction, with intermittent monitoring flights throughout operations and maintenance.

For all project phases, the health effect would be very high due to the potential for serious health injury and loss of life if an accident were to occur. The high intensity of the effect reflects that those affected may not be able to adapt to the health impact or maintain pre-impact levels of health. The geographic extent of this potential impact would be low because impacts would be limited to individual cases, although the personnel affected may be from any of the affected communities in the EIS Analysis Area. The duration of this impact would be high for the construction phase (3-4 years) and very high for the operations and maintenance (27 years) and closure, reclamation, and monitoring (> 50 years) phases. The potential for accidents and injuries due to air transportation is low because it is not a leading cause of accidents and injuries in the region; therefore, the likelihood of this impact occurring is considered unlikely (10-33 percent). The summary impact to human health due to air transportation would be medium.

<u>Unintentional Accidents and Injuries Morbidity and Mortality Rates due to Surface Transportation</u>

Increases in surface transportation accidents and injuries (mortality and morbidity rates) could occur during any of the project phases. Motor vehicle accident is one of the reported causes of death in region, with the majority occurring from snowmachine travel (BVS 2014, as cited in NewFields 2015). The communities closest to the proposed mine site are not connected by roads. Surface travel occurs via foot, all terrain-vehicles, and snowmachines (Section 3.23.2.2.1, Transportation). The few existing primitive trails in the vicinity of the mine site would be closed throughout all project phases to limit public access for safety considerations.

A new 30-mile access road between the Angyaruaq (Jungjuk) Port and the mine site would be used seasonally to transport fuel and cargo. This road would be located in an area that is remote, and not pass near existing settlements or communities, nor would it connect with an existing road system. Public access would not be authorized during the operational life of the mine; traffic on this road would be limited to vehicles associated with the Donlin Gold Project (2,917 annual trips made by tractor-trailers). Due to the access control and lack of connection with existing roads, there would be no effect on existing surface transportation from Angyaruaq (Jungjuk) Port to the mine site. Travel related to the construction and operations of the transportation facilities in Bethel is expected to cause a slight increase in daily traffic in the community. In addition, if construction of additional fuel storage were to occur at Dutch Harbor, minimal traffic would be added to local roads. The additional traffic from trips by construction workers and suppliers to the two ports (i.e., Bethel and Dutch Harbor) would be of low intensity, would not noticeably alter local traffic patterns, and would be easily accommodated by the existing road network (Section 3.23.2.2.2, Transportation).

Public access to the natural gas pipeline ROW by way of surface transportation would be limited over the majority of the pipeline due to the remoteness of the route. Temporary access roads would be required during construction, including a winter corridor (ice road) and gravel temporary and shoofly roads. All roads would be reclaimed after the construction of the natural gas pipeline. After construction of the pipeline, a site would be developed in the Beluga area to stage and store materials used for operations and maintenance. It is anticipated that there would be a slight increase in the use of this facility during the operations and maintenance phase, which could be noticeable in the vicinity of Beluga. However, given the current low levels of use by local Beluga residents and other business operations, there would be minimal impact to surface transportation resources (Section 3.23.2.2.3, Transportation).

Similar to air transportation, the health effect would be very high due to the potential for serious health injury and loss of life if an accident were to occur. The intensity and geographic extent of the effect would be low due to low levels of surface transportation, with low speeds of travel, and having limited nexus with public surface transportation systems. The duration of this impact would be high for the construction phase (3-4 years) and very high for the operations and (27 years) and closure (> 50 years) phases. The likelihood of increases in surface transportation accidents and injuries in Bethel, Dutch Harbor, and Beluga is considered unlikely (10-33 percent), as public access would be restricted from the industrial sites. The summary impact to human health due to surface transportation would be medium.

Unintentional Accidents and Injuries Morbidity and Mortality Rates due to Water Transportation

The proposed project would include shipping cargo from marine terminals in Seattle and Vancouver via ocean barges up the Kuskokwim River to a cargo terminal in Bethel. At Bethel, cargo would be transferred from ocean barges to river barges for towing up the Kuskokwim River to the Angyaruaq (Jungjuk) Port. Cargo would then be transported by truck from the Angyaruaq (Jungjuk) Port to the mine site. Heavy barge traffic upriver of Bethel is not unprecedented. Between calendar years 2007 and 2011, an average of 405 commercial vessel trips per year was logged on the Kuskokwim River. Based on interviews with Kuskokwim River barge operators conducted in November and December of 2013, approximately 68 freight and fuel barge tows per year serve the villages upriver of Bethel (Ausdahl 2013; Clevenger 2013; Faulkner 2013; Jansen and Stauffer 2014; Leary 2013; Myers 2013, as cited in Section 3.23, Transportation).

During the construction phase, it is estimated that about 65 barge round trips per year would be required to transport cargo and fuel from Bethel to the Angyaruaq (Jungjuk) Port; the additional barge traffic during the construction phase would represent a modest increase in river traffic relative to baseline. During the operations and maintenance phase, the proposed project would require about 122 cargo and fuel barge tows round trip per season from Bethel to the Angyaruaq (Jungjuk) Port, which would represent a notable increase in river traffic along this segment. The elevated traffic during the operations phase could result in congestion, particularly along narrow channel segments. After closure of the mine, the Angyaruaq (Jungjuk) Port would be removed and reclaimed, with only a small barge landing remaining to support the monitoring phase (Section 3.23.2.2, Transportation). It is expected that during the monitoring phase, water transportation would be substantially reduced possibly returning to near baseline levels.

During pipeline construction, pipe and other heavy construction materials would be shipped by ocean barge from Seattle and/or Vancouver to the Port of Anchorage for temporary storage and then to the Beluga barge landing. The Port of Anchorage and Beluga Port would experience a temporary and slight increase in water transport shipments. Other materials used for pipeline construction would be barged on the Kuskokwim River from Bethel to the Angyaruaq (Jungjuk) Port and Kuskokwim Landings, near Devil's Elbow at the point where the pipeline crosses the Kuskokwim River. At project closure, decommissioned pipeline materials (e.g., above-ground pipeline facilities) that can be salvaged or recycled would be transported to Anchorage by barge from the Beluga barge landing to the Port of Anchorage where they would be dismantled, salvaged, recycled, and disposed of as appropriate. The increase in barge traffic at the Beluga Port and Port of Anchorage as a result of these activities would be minimal relative to other port traffic (Section 3.23.2.2.3, Transportation).

The potential for accidents and injuries due to water transportation would be primarily associated with transportation on the Kuskokwim River because it is the principal water body in the region that supports local and commercial vessel traffic and commercial and subsistence fishing. Guided fishing trips are also provided commercially for non-local fishermen on some Kuskokwim River tributaries. In addition, hunting for moose, bear, caribou, marine mammals, and waterfowl, and gathering berries and firewood are often associated with travel by boat to access these resources. Many stakeholders have expressed concern about the potential for accidents and related spills due to increased project-related barge traffic. Barge strandings could occur, but are not likely to cause a human health risk; reported industrial accidents associated with barge traffic in the EIS Analysis Area are very low (Section 3.23.2.2.3, Transportation).

Similar to air and water transportation, the health effect would be very high due to the potential for serious health injury and loss of life. The intensity of the effect would be high because those affected may not be able to adapt to the health impact. The geographic extent of this potential impact would be low because impacts would be limited to individual cases although the individuals may come from any of the communities in the EIS Analysis Area. The duration of this impact would be high for the construction phase (3-4 years) and very high for the operations and maintenance (27 years) and closure, reclamation, and monitoring (> 50 years) phases. The likelihood of a water transport accident occurring is considered unlikely (10-33 percent). The summary impact to human health due to water transportation would be medium.

Intentional Injury: Suicide Rate

Increases in suicide rates could occur due to psychosocial stress and family instability from anxiety, fear, poor mental health, and depression. Suicide is noted by the Alaska Trauma Registry (ATR) as the most common cause of fatal injuries in the Bethel Census Area (ADHSS undated; ATR 2011, both as cited in NewFields 2015). During 2004 to 2008, the most common cause of non-fatal injury requiring hospitalization for the Y-K region was attempted suicide (23 percent of all non-fatal injuries) (ATR 2011, as cited in NewFields 2015). Expectations regarding suicide rates should be treated with caution since the causes of suicide are complex and unpredictable and may be easily overestimated or underestimated.

For all project phases, the health effect would be very high due to the potential for serious health injury and loss of life. The intensity of the effect would be very high because those affected would not maintain pre-impact levels of health. The geographic extent of this potential impact would be low because impacts would be limited to individual cases in the EIS Analysis Area. The duration of this impact would be high for the construction phase (3-4 years) and very high for the operations and maintenance (27 years) and closure, reclamation, and monitoring (>50 years) phases. The likelihood of this impact occurring is considered as unlikely on a large scale (10-33 percent). The summary impact to human health due to increases in suicide rates would be medium for all project phases.

Alternative 2, HEC 2 Impact Summary: Accidents and Injuries

For accidents and injuries, potential impacts due to unintentional accidents (air, surface and water transportation) and intentional injuries (suicide) were evaluated. The summary impact level (considering the combined ratings for the three phases) is medium, acknowledging a lower level of estimated impact associated with surface transportation. Expectations regarding suicide rates should be treated with caution since the causes of suicide are complex and unpredictable and may be easily overestimated or underestimated. The accidents and injuries discussed in this section are generally considered to be events with low probability of occurrence, but high consequence if they did occur.

Table 3.22-18: Summary of HEC 2 Impacts: Accidents and Injuries

Potential Impact	Project Component	Project Phase	Negative/ Positive	Health Effect	Magnitude/ Intensity	Duration	Geographic Extent	Severity Ranking	Likelihood Rating	Impact Rating	Impact Level
Increase in unintentional accidents and injuries morbidity and mortality rates due to air transportation	All components: Mine Site, Transportation Facilities, Natural Gas Pipeline	Construction	–	Very high (3)	Very high (3)	High (2)	Low (0), individual cases	**8**	10-33%	**	**Medium**
		Operations and Maintenance		Very high (3)	Very high (3)	Very high (3)	Low (0), individual cases	**9**	10-33%	**	**Medium**
		Closure, Reclamation, and Monitoring		Very high (3)	Very high (3)	Very high (3)	Low (0), individual cases	**9**	10-33%	**	**Medium**
Increase in unintentional accidents and injuries morbidity and mortality rates due to surface transportation	All components: Mine Site, Transportation Facilities, Natural Gas Pipeline	Construction	–	Very high (3)	Low (0)	High (2)	Low (0), individual cases	**5**	10-33%	**	**Low**
		Operations and Maintenance		Very high (3)	Low (0)	Very high (3)	Low (0), individual cases	**6**	10-33%	**	**Low**
		Closure, Reclamation, and Monitoring		Very high (3)	Low (0)	Very high (3)	Low (0), individual cases	**6**	10-33%	**	**Low**
Increase in unintentional accidents and injuries morbidity and mortality rates due to water transportation	All components: Mine Site, Transportation Facilities, Natural Gas Pipeline	Construction	–	Very high (3)	High (2)	High (2)	Low (0), individual cases	**7**	10-33%	**	**Medium**
		Operations and Maintenance		Very high (3)	High (2)	Very high (3)	Low (0), individual cases	**8**	10-33%	**	**Medium**
		Closure, Reclamation, and Monitoring		Very high (3)	High (2)	Very high (3)	Low (0), individual cases	**8**	10-33%	**	**Medium**
Increase in intentional injury: suicide rate	All components: Mine Site, Transportation Facilities, Natural Gas Pipeline	Construction	–	Very high (3)	Very high (3)	High (2)	Low (0), individual cases	**8**	10-33%	**	**Medium**
		Operations and Maintenance		Very high (3)	Very high (3)	Very high (3)	Low (0), individual cases	**9**	10-33%	**	**Medium**
		Closure, Reclamation, and Monitoring		Very high (3)	Very high (3)	Very high (3)	Low (0), individual cases	**9**	10-33%	**	**Medium**

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3.22.4.2.3 HEC 3: EXPOSURE TO POTENTIALLY HAZARDOUS MATERIALS

Concern about the potential for adverse health effects associated with exposure to hazardous chemicals is a common and legitimate concern expressed by communities in the EIS Analysis Area. As noted in Section 3.22.3.2, members of the affected communities expressed concerns about exposure to hazardous materials associated with the project and the potential for these constituents to affect human health. As described in NewFields (2015), a summary of specific issues that were raised during Scoping meetings and other project meetings were health concerns related to the following:

- Release of mercury and dust emissions to air from point and fugitive sources;
- Release of mercury and other metals to surface water and groundwater;
- Uptake of mercury and other chemicals into vegetation, fish, waterfowl, wildlife, and large game;
- Handling and use of mercury and worker exposure to mercury;
- Release of acid rock drainage (ARD) to the environment;
- Usage and release of cyanide to the environment and uptake by fish and wildlife;
- Increased exposure to arsenic; and
- Accidental releases of diesel, fuel oil, and explosives associated with barge traffic, air traffic, and truck traffic.

Overall, the health concerns are related to how hazardous constituents would be stored, handled, and used at the mine site, how emissions and releases would be controlled and managed, and how accidental spills and releases related to the transportation and pipeline components would be minimized so that there are no unacceptable exposures to on-site workers or off-site communities. Refer to Table 3.22-20 for a summary of impacts due to exposure to potentially hazardous materials. Impacts would be considered low for all components and phases.

Spill risk is discussed in Section 3.24, including possible spill scenarios involving fuels (i.e., diesel and liquefied natural gas [LNG]), mercury, cyanide, and tailings. Although accidents, spills, and leaks may create receptor exposure to hazardous constituents, the nature and circumstances of such hypothetical events are highly variable. Although spill scenarios may be quantified, there would be variability in the effectiveness of the remediation efforts, the fate and transport of the chemicals in the various media, and the subsequent concentrations in exposure media. Refer to Section 3.24 for analysis of spill scenarios.

Sources, Exposure Media, and Chemicals of Potential Concern

When chemicals present in the environment come into contact with human or ecological receptors, a complete exposure pathway is created. An effective way to understand the potential for health risks related to hazardous constituents in the environment is to understand two critical concepts: first, there has to be exposure to the chemical, and second, the exposure has to be high enough that adverse health effects may be a concern (EPA 1989).

An exposure pathway includes the following components:

- A source of contamination (e.g., release of mercury used in mine operations activities);
- A mechanism of release and transport pathway to an affected medium (e.g., runoff to offsite creeks and food-web uptake by fish);
- A receptor (e.g., subsistence fisher); and
- An exposure route (e.g., ingestion of fish).

An exposure pathway is considered complete when, and only when, all of the above component elements are present. If any of these elements are missing, then the exposure pathway is considered incomplete. In addition, some pathways may be complete, but inconsequential since the level of exposure may not be high enough to be a health concern.

This source to receptor exposure pathway framework is used to evaluate the potential impacts of project-related hazardous constituents on human health since it provides a comprehensive and transparent approach to identifying and evaluating health issues related to hazardous constituents.

Conceptual Site Models

A schematic representation of complete and incomplete exposure pathways for a site is called an exposure-based conceptual site model (CSM). Based on the project description, planned project controls and measures planned for handling and management of emissions, discharges, and waste, and an understanding of the distribution of affected communities and land uses in the area, CSMs were developed for each of the project components (Figure 3.22-4, Figure 3.22-5, and Figure 3.22-6) for Alternative 2.

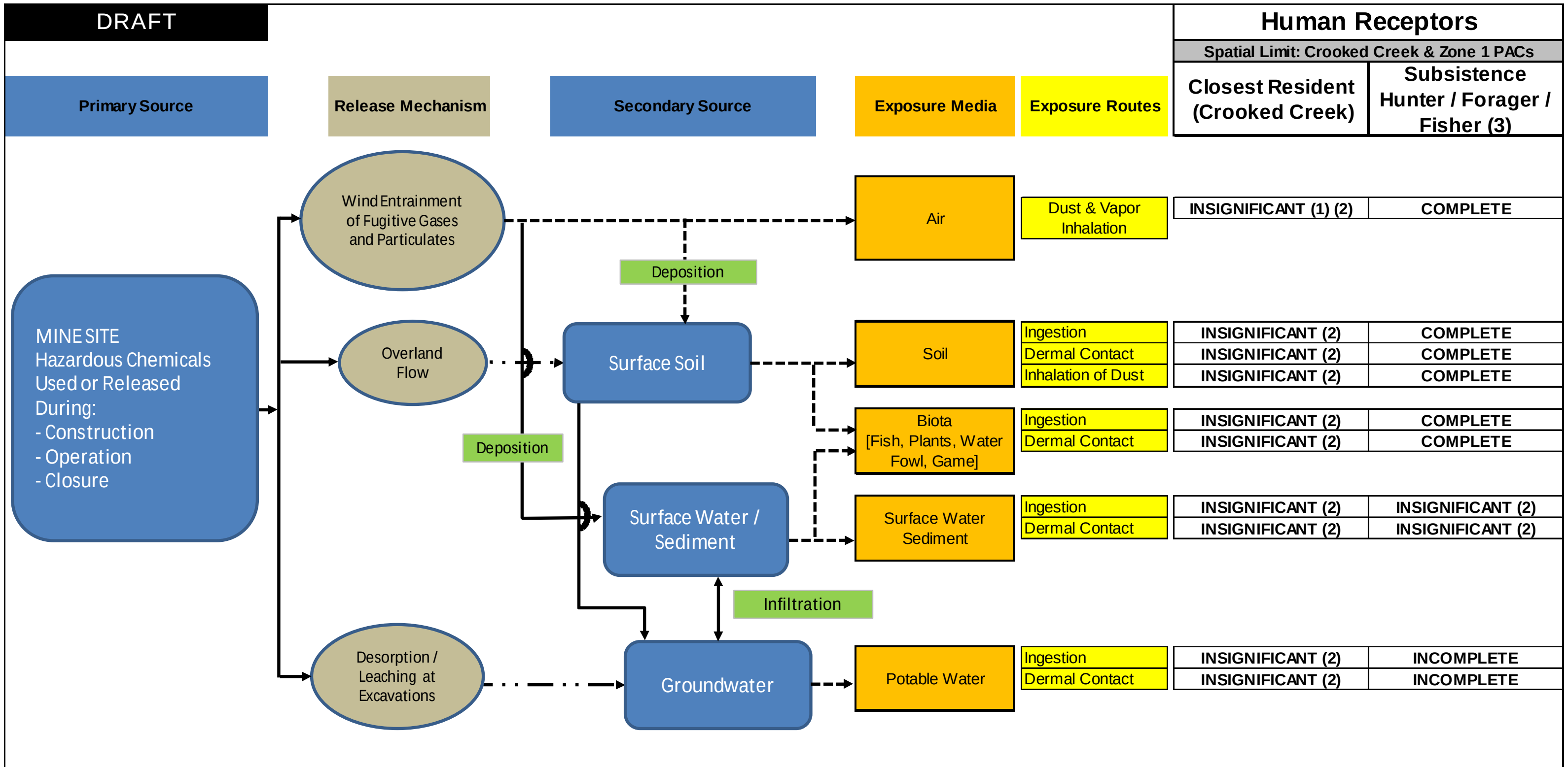
The CSMs illustrate exposure pathways that may be complete or incomplete for the two major kinds of populations who may be present in the general area: residents and subsistence users. Protection of employees and workers who may be involved in handling and use of hazardous constituents is covered in the project health and safety plans and is not within the scope of this evaluation. Workers and employees typically have training and monitoring precautions to ensure their health and safety. Workers who are housed in enclave workforce camps at the mine site would be prohibited from engaging in fishing and hunting activities in the vicinity of the mine site, as described in Section 3.21.6.1.3, Subsistence.

The closest residential community to the mine site is Crooked Creek, located about 10 miles southeast. Subsistence hunters and fishers from Crooked Creek and the other communities may range closer to the proposed project components during their hunting and fishing activities.

CSMs were not developed for the other alternatives since they are similar to Alternative 2, with regard to human health analysis.

Exposure Pathway Assessment

This section describes a screening-level evaluation of the completeness of potential exposure pathways to project-related releases of hazardous substances for each project component. The exposure pathway was considered complete for the mine site and transportation facilities, and impacts are evaluated by component and phase as applicable. The natural gas pipeline was incomplete for most pathways. Air quality and groundwater quality were evaluated for the natural gas pipeline.



LEGEND

The CSM is based on the Proposed Alternative Two and does not evaluate exposure pathways based on accidents, spills, or failures of mitigation measures scenarios. The proposed release, transport, and exposure to chemicals are due to project activity and does not include ambient, background, or naturally occuring chemicals.

Resident Receptors are Crooked Creek residents approximately 10 miles from the mine site.

Project related workers are assumed to be covered under the project health & safety plans and are not included in this CSM

Subsistence Receptors are likely Crooked Creek residents but may be from other villages further away.

Exposure Pathways: "Complete" refers to a potential exposure pathway resulting in receptor exposure of project related hazardous constituents in various media during any of the phases (i.e., construction, operations, and closure). "Incomplete" refers to a potential exposure pathway with a break in the path that prevents receptors from

— · · → Transport Pathway is incomplete due to proposed mitigation measures expected to ensure containment of groundwater and surface water run-off (Section 3.7.1.2.1)

- - - - → Transport pathway is complete, but insignificant based on modeled concentrations

——→ Transport pathway is complete

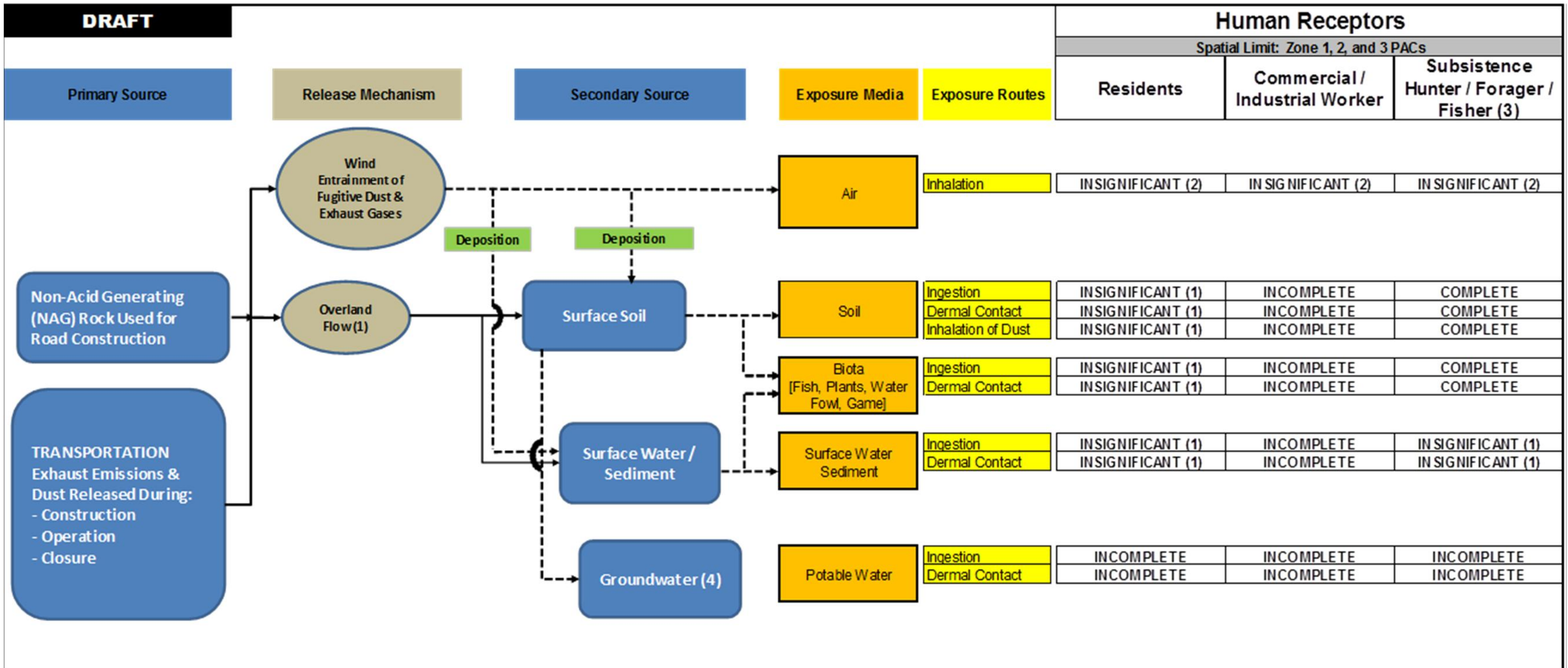
(1) Based on predicted air emmissions calculations (Air Sciences, 2014)

(2) Exposure is due to deposition transport to soil, sediment, and surface water with potential migration into biota and groundwater. Based on low modeled concentrations of mercury (Section 3.8: Table 3.8-22 Mercury Ambient Modeling Results and Table 3.8-23 Estimated Annual Average Deposition Flux due to Donlin Stack and Fugitive Sources) [Arcadis, 2014].

(3) Exposure to subsistence receptors increases based on proximity to the Mine Site boundary. Exposure Pathway designation is for receptors close to the boundary.

Conceptual Site Model (CSM)

Figure 3.22-4: Mine Site Conceptual Site Model



LEGEND

The CSM is based on the Proposed Alternative Two and does not evaluate exposure pathways based on accidents, spills, or failures of mitigation measures scenarios. The proposed release, transport, and exposure to chemicals are due to project activity and does not include ambient, background, or naturally occuring chemicals.

Resident Receptors are Crooked Creek residents approximately 10 miles from the mine site.

Commercial / Industrial Workers are located at the transportation route major ports and harbors (not associated with the project).

Subsistence Receptors are likely Crooked Creek residents but may be from other villages further away.

Exposure Pathways: "Complete" refers to a potential exposure pathway resulting in receptor exposure of project related hazardous constituents in various media during any of the phases (i.e., construction, operations, and closure). "Incomplete" refers to a potential exposure pathway with a break in the path that prevents receptors from exposure to project related hazardous constituents.

- - - - → Transport pathway is complete, but insignificant based on modeled concentrations (Environ, 2014)

——→ Transport pathway is complete

(1) This transport pathway is limited to the local Mine Site roads and only relevant to receptors nearby

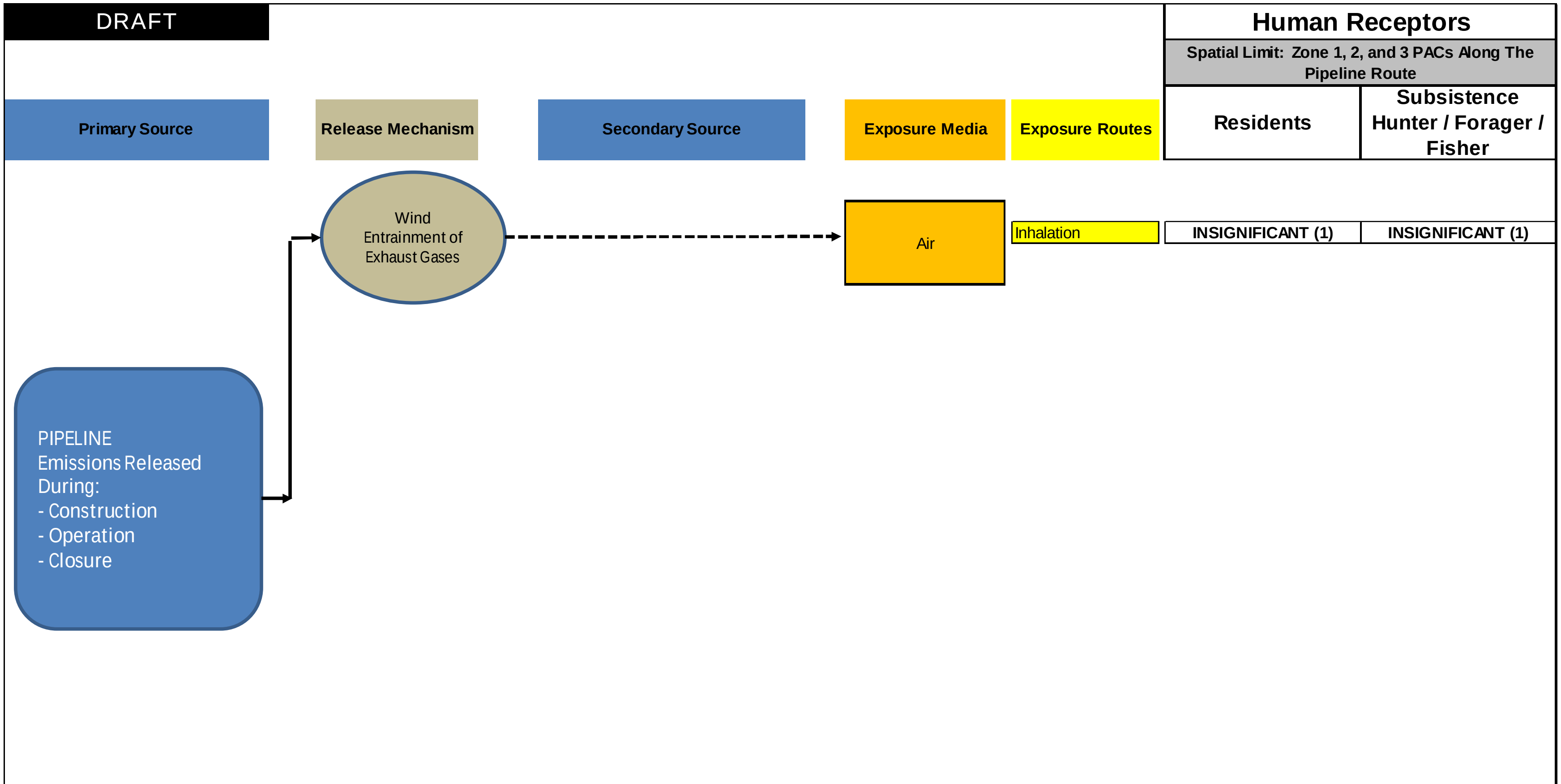
(2) Impacts to air quality are expected to be below permit thresholds (Air Sciences, 2014)

(3) Exposure to subsistence receptors increases based on proximity to the Mine Site boundary. Exposure Pathway designation is for receptors close to the boundary.

(4) The transport pathway for groundwater is localized near Mine Site (NAG based) roads only and therefore too distant from residents to be a potable water source.

Conceptual Site Model (CSM)

Figure 3.22-5: Transportation Facilities Conceptual Site Model



LEGEND

The CSM is based on the Proposed Alternative Two and does not evaluate exposure pathways based on accidents, spills, or failures of mitigation measures scenarios. The proposed release, transport, and exposure to chemicals are due to project activity and does not include ambient, background, or naturally occuring chemicals.

Exposure Pathways: "Complete" refers to a potential exposure pathway resulting in receptor exposure of project related hazardous constituents in various media during any of the phases (i.e., construction, operations, and closure). "Incomplete" refers to a potential exposure pathway with a break in the path that prevents receptors from exposure to project related hazardous constituents.

- - - - → Transport pathway is complete, but insignificant based on the large distances between the source to the potential receptors

——→ Transport pathway is complete

(1) Impacts to air quality are expected to be below permit thresholds (Air Sciences, 2014)

Conceptual Site Model (CSM)

Figure 3.22-6:
Pipeline
Conceptual Site Model

Mine Site

The complete and incomplete pathways for the mine site component are illustrated in Figure 3.22-4.

Air Quality

Air pollutants associated with the mine site may be inhaled by members of the affected communities resulting in consequences to human health. Emissions to air that may affect human health include criteria air pollutants such as particulate matter of various particle sizes and hazardous air pollutants such as cyanide and mercury. Community members and stakeholders have expressed particular concern about mercury which may be emitted during mine site activities. Air quality modeling assuming worst-case conditions was performed to evaluate compliance with applicable air quality criteria and permitting limits and is described further in Section 3.8, Air Quality.

Expected emissions of criteria pollutants (particular matter [PM_{10}, $PM_{2.5}$], carbon monoxide (CO), ozone (O_3) and oxides of nitrogen and sulfur [NOx, SOx], and hazardous air pollutants (antimony, arsenic, mercury, volatile organic compounds [VOCs]) from both fugitive and mobile sources were evaluated with respect to permitting requirements (Table 3.8-15, Air Quality). All pollutants were found to be well below the air quality standards and threshold values that would trigger permitting requirements. Permitting requirements typically take human health into consideration along with other factors.

<u>Construction</u>

Health effects related to air quality during the construction phase are considered to be medium (no intervention required), of low intensity (below permitting thresholds), temporary (3 years or less), and a medium / local geographic extent. Therefore, the impacts to human health through exposure to project-related hazardous constituents and hazardous air pollutants during the construction phase are ranked low.

<u>Operations and Maintenance</u>

During the operations phase, criteria and hazardous air pollutants (HAPs) may be emitted from numerous fugitive, mobile, and stationary sources associated with mine site activities, as listed in Table 3.8-16 and Table 3.8-17. Arsenic, lead, cyanide, and mercury are grouped together as HAPs and mercury is also presented individually. Predicted loads and concentrations of all pollutants, including those that would trigger the need for air permits, were found to be substantially lower than the maximum allowed permit limits. Ambient mercury modeling showed expected exposure at the mine site of less than 1 percent of the most stringent standard for annual exposure with no observable adverse effect (0.2 $\mu g/m^3$).

Impacts to human health related to air quality during the operations phase are considered to be the same as during the construction phase, with the exception of the greater duration of the operations phase. Therefore, the impacts to human health through exposure to project-related hazardous constituents and hazardous air pollutants during the operations phase are ranked low.

<u>Closure, Reclamation, and Monitoring</u>

Donlin Gold's goals for reclamation of the mine site during and after operations include shaping, vegetating, and stabilizing the land for post-reclamation land use (SRK 2012f). Some reclamation activities would occur concurrently with project activities during the operations and maintenance phase, thus mitigating impacts during that phase.

Closure and reclamation activities such as reclaiming roads (although some roads would remain for post-reclamation monitoring); backfilling the pit and stabilizing pit highwalls; grading, contouring and restoring the WRF; covering the tailings impoundment; and removing material, equipment, and buildings would require considerable grading including soil amendments and re-vegetation as necessary. These activities would continue for a period of 5 years after operations cease (SRK 2012f), thus would be of very high / long-term duration. Mine site emissions during the closure and reclamation phase would be below air quality permit thresholds, and would meet regulatory standards.

Impacts to human health related to air quality during the closure phase would be the same as during the operations phase. Therefore, the impacts to human health through exposure to project-related hazardous constituents and hazardous air pollutants during the closure phase are ranked low.

Surface Water Quality

As designed, Donlin Gold would not discharge mine-contacted waters without treatment to applicable water quality regulatory standards. The primary exposure pathway by which surface water quality may affect human health is if people use untreated contaminated surface water. Surface water from the creeks in the vicinity of the mine site is not used for water supply purposes since the nearest residences are at Crooked Creek which is 10 miles away. The nearest use of surface water for potable purposes is the Kuskokwim River. Water from the Kuskokwim River is considered fit for all purposes, including drinking and several villages between Crooked Creek and Bethel draw drinking water directly from the river (Section 3.7.2.1.1, Water Quality).

It should be noted that some project related hazardous chemicals are naturally occurring in surface waters such as arsenic, cyanide, and mercury. Table 3.7-2 through Table 3.7-4 (Water Quality) presents surface water quality data compared to water quality standards. Arsenic was detected above the water quality standard frequently at multiple sampling sites. Cyanide showed two detections out of 355 samples above the most stringent water quality criteria. (Section 3.7.2.1.1, Water Quality) To evaluate the effects of construction, operations, and post-closure activities at the mine site, expected concentrations in surface water were estimated for numerous metals, including arsenic, cyanide, and mercury. The predicted concentrations were compared to the EPA's Ambient Water Quality Criteria (AWQC) and Alaska's Water Quality Standards that are protective of human health for potable uses as well as protective of aquatic life. It is emphasized that the human health-based AWQC values are intended to be protective of long-term water consumption and even if a short-term exceedance were to occur, this would not necessarily result in adverse health effects. Additional discussion is provided in Water Quality Section 3.7.2.2.

Construction

The closest creeks potentially affected by mine site activities during the construction phase are American Creek (draining into Crooked Creek), Crooked Creek, and Anaconda Creek, all of which drain into the Kuskokwim River. There are three ways that surface water may be impacted by mine site construction activities: discharge of treated water, runoff from construction materials, and erosion / sedimentation. Although total or dissolved concentrations of several metals (aluminum, antimony, arsenic, copper, iron, lead and manganese) may exceed the AWQC in untreated contact and process wastewater, all wastewater generated from the mine site would be treated to meet AWQCs prior to discharge to Crooked Creek. Construction BMPs (including collection of runoff and seepage), and erosion control practices would limit contributions of chemicals from runoff and sedimentation above AWQCs to American Creek and Anaconda Creek to localized areas, prior to their confluence with Crooked Creek and the Kuskokwim River. Therefore, water management and water treatment measures would address surface water quality concerns prior to intake locations for water supply use.

Human health effects related to surface water during the construction period are considered to be low (effects not perceptible), of low intensity (no exceedances of AWQC), of temporary duration (3 years or period of construction), medium / localized in extent and low in likelihood due to the control measures and distance to nearest water usage in the Kuskokwim River. Therefore, the impacts to human health through exposure to project-related hazardous chemicals in surface water during the construction phase are ranked low.

Operations and Maintenance

During the operations phase, the primary industrial uses of water would be from groundwater related to dewatering, and well water and surface water from Snow Gulch for contact and processing. Pit dewatering water, contact, and process waters would be collected and reused for processing. Some excess water would be treated to meet water quality standards and discharged.

Contact water would be treated to attain AWQC prior to discharge to Crooked Creek. Although total or dissolved concentrations of several metals (aluminum, antimony, arsenic, copper, iron, lead, manganese, and mercury) may exceed the AWQC in untreated contact and process wastewater (Table 3.7-33, Water Quality), all wastewater generated from the mine site would be treated to meet AWQCs prior to discharge to Crooked Creek (Table 3.7-34, Water Quality). Other changes that may occur during operations, such as reduced flows to Crooked Creek and geochemical changes to wetlands along the creeks, are not expected to result in changes to surface water quality that would be different from baseline conditions or affect human health. Inputs of mercury from atmospheric and runoff sources are not expected to exceed the drinking water standard of 2,000 ng / L for total mercury, based on modeling estimates (Table 3.7-35, Water Quality). There are no surface water quality criteria for methylmercury which may affect human health by consumption of mercury-contaminated fish. Mercury concentrations are addressed further in the cumulative effects discussion for Surface Water Quality (Section 4.3.1.7.2, Chapter 4, Cumulative Effects).

Human health impacts related to surface water quality during the operations phase would be similar to the construction phase, except for the greater duration (very high) of the operations phase. The impacts to human health are ranked low.

Closure, Reclamation, and Monitoring

After closure of the mine, all treatment water, runoff, and seepage would be retained on site in the pit lakes and treatment facilities and treated in the post-closure waste treatment plant. Discharge to surface water bodies would not be allowed until the stored and treated water has met AWQC or would be diluted sufficiently by receiving waters so that AWQC would not be exceeded, several years after closure. Although concentrations of some metals may exceed the AWQC seepage and treatment water (Table 3.7-37, Water Quality), conditions in surface water quality are expected to be similar to operations phase conditions, since treatment of mine site water would continue after closure.

Health effects related to surface water quality during the closure phase are considered to be the same as during the operations phase. Therefore, the impacts to human health through exposure to project-related hazardous chemicals in surface water during the closure phase are ranked low.

Ground Water Quality

Since many of the rural communities lack municipal water and sanitation systems, water for potable use is drawn from wells and from the Kuskokwim River. There may be groundwater sources (wells or springs) that are in use associated with residences or camps. In many areas near streams, groundwater is shallow enough to be accessed with small-diameter driven point wells that would be unlikely to be registered in public databases. A community water supply well is located in the village of Crooked Creek about 10 miles downstream of the proposed mine site and ½-mile southwest of the confluence with the Kuskokwim River. The drinking water source protection area identified by ADEC (2013c) for these groundwater supplies extends across the mouth of Crooked Creek (Section 3.6.1.5.1, Groundwater Hydrology). The typical depth from which groundwater is drawn in the wells is unknown. Therefore, any effects to human health related to groundwater quality would occur only if project-related contamination were to migrate out to where groundwater usage may be occurring. Concentrations of aluminum, iron, manganese, and arsenic exceed MCLs (Section 3.7.2.2.1, Water Quality) under baseline conditions in the shallow groundwater in some areas of the watersheds of Snow Gulch, American Creek, Anaconda Creek, and Crooked Creek.

As noted in Section 3.7.3.2.3, Water Quality, effective water management during the construction, operations, and closure phases, would limit impacts to groundwater quality to discrete portions of the EIS Analysis Area. The principal mechanisms responsible for effects to groundwater quality at the mine site would be inputs of seepage from the WRF and TSF to shallow groundwater resources underneath and immediately adjacent to the WRF, and the discharge of water from the pit to the surrounding deep bedrock groundwater (greater than 600 feet below the surface [Section 3.6.1.3.3, Groundwater Hydrology]), which would occur for a period of approximately 8 years following the cessation of pit depressurization, based on groundwater flow model analysis. Groundwater that could potentially be contaminated by inputs of WRF seepage would flow towards the pit, and the spatial extent of the impacts would be limited because the contaminated groundwater would be intercepted by the pit and the pit dewatering system. Similarly, seepage and leakage from the TSF would be captured, contained, and treated, and impacts to groundwater would be minimized.

Construction

During the construction phase, concentrations of arsenic, antimony, and selenium may exceed water quality criteria due to interactions and leaching between waste rock and water. However, these exceedances would be limited to shallow groundwater within a discrete and localized portion of the mine site.

There is no consumption of groundwater within the mine site area by local communities. Off-site migration of contaminated groundwater would not occur since the onsite groundwater would be captured and treated to AWQC prior to discharge to Crooked Creek.

Health effects related to groundwater quality during the construction phase are considered to be low (effect not perceptible), of low intensity (no exceedances of AWQC in potable groundwater), of very high / long-term duration (as long as metal concentrations are locally elevated), medium / localized in extent (on-site only, not in off-site areas of groundwater usage), and low in likelihood due to the control measures and distance to nearest water usage from wells. Therefore, the impacts to human health through exposure to project-related hazardous chemicals in ground water during the construction phase are ranked low. Additional detail is provided in Water Quality Section 3.7.3.2.3.

Operations and Maintenance

During operations, concentrations of metals such as arsenic, antimony and selenium could exceed water quality criteria in limited areas in the vicinity of the WRF and the pit dewatering system, due to continued infiltration and leaching into shallow groundwater. Similar to the construction phase, this groundwater would be captured and treated on site. Seepage and leakage from the TSF would also be captured and treated on site. Alterations to wetland hydrology and geochemical conditions may result in further increases in concentrations of metals that are already above MCLs in shallow groundwater in some of the wetland areas in the watersheds of Snow Gulch, American Creek, Anaconda Creek, and Crooked Creek. Since it is unlikely that shallow groundwater from these areas would be used for potable purposes, impacts to human health would not be expected. Impacts to human health related to exposure to project-related groundwater contamination during the operations phase would be low, the same as for the construction phase.

Closure, Reclamation, and Monitoring

No impacts to off-site potable groundwater are anticipated in the closure and post-closure phase since all on-site groundwater that requires storage and treatment would be captured and remain on-site. Impacts to human health related to exposure to project-related groundwater contamination during the closure phase would be low, the same as for the construction phase.

Soil Quality

As noted in Section 3.2.3.2.4, Soils, no pre-existing contaminated conditions of environmental concern were identified at the mine site; thus, effects from exposure of existing contaminated soils during construction, operations, or closure are not expected to occur.

Although metals are naturally occurring minerals, mining activities may sometimes result in metal concentrations in soil that are elevated above levels that may be of human health concern. Soil quality could be affected by fugitive dust settling on soil, or gaseous mercury emissions that wash out of the atmosphere as wet or dry deposition. Fugitive dust generated during mine site construction (pre-production) and operations could potentially result in elevated concentrations of metals in soils surrounding the mine site over time through dust deposition. The dust particulates would reflect the minerals in the source material. Gaseous mercury would be emitted from the mill facility, WRF, and TSF.

Levels of metals present in baseline soils are listed in Table 3.2-2, Soils, and compared to ADEC soil cleanup levels, which are administered through the State's Contaminated Sites Program. Arsenic was the only metal which exceeded ADEC levels under baseline conditions. Predicted maximum concentrations for numerous metals associated with mine site, ores, and tailings were estimated by a variety of conservative models for air emission, dispersion deposition and partitioning, over an assumed period of construction and operations, as described in Section

3.2.3.2.4, Soils. Only antimony, arsenic and mercury were at levels that exceeded ADEC's soil cleanup levels in a source material or baseline soil.

At the end of the construction and operation phases, predicted concentrations of antimony and mercury in soils are estimated to be well below the ADEC human health-protective levels (Section 3.2.3.2.4, Soils). Even though the end-of-mine-life concentrations for antimony (11.2 mg/kg) and mercury (0.399 mg/kg) may be slightly higher than baseline levels, they do not pose a concern to human health. Predicted maximum levels of arsenic in soil may reach 174 mg/kg, which is greater than the ADEC soil clean up level of 4.5 mg/kg. The predicted value is approximately 5 mg/kg or 3 percent higher than the upper end estimate of the baseline (169 mg/kg, estimated as the 95 percent upper confidence limit on the mean). The clean-up level of 4.5 mg/kg represents an acceptable target risk level of 1 in 100,000 (1×10^{-5}) for excess cancer risk, i.e., it represents the probability of developing cancer if a person was exposed to arsenic in soil by direct contact (incident ingestion, dermal contact, outdoor inhalation of dust) over a 30-year exposure period. The risk levels associated with the site soil concentrations were estimated and summarized in Table 3.22-19.

Table 3.22-19: Cancer Risk for Arsenic Concentration in Soil

Category	Arsenic Concentration in soil (mg/kg)	Associated Excess Cancer Risk Level
ADEC Clean Up Level (a)	4.5	1×10^{-5}
Baseline Soil (Mean) (b)	78.8	1.8×10^{-4}
Baseline Soil (95% UCL) (c)	169	3.8×10^{-4}
Predicted End-of-Mine-Life Soil (d)	174	3.9×10^{-4}
Incremental Risk from Baseline UCL to End of Life (e)	--	1×10^{-5}

Notes:

From ADEC 2014. Method 2 Cleanup Levels for Soil, Table B1.
Baseline soil mean from Table 3.2-12. Risk is calculated as [(78.8/4.5)/10^{-6}]
Baseline soil UCL from Table 3.2-12. Risk is calculated as [(169/4.5)/10^{-6}]
Predicted end-of-mine-life soil concentration from Table 3.2-12 (Soils). Risk is calculated as [(174/4.5)/10^{-6}]
Incremental Risk=Predicted End-of-mine-life risk – Baseline soil UCL risk

For contaminated sites, the State of Alaska regulations generally require that the risk associated with hazardous substances at a site should not exceed a risk level of 1×10^{-5} (i.e., the probability of an individual developing cancer from a lifetime of exposure should not exceed 1 in 100,000). Considering that the background rate of cancer risk (from all causes) for the U.S. population is 1 in 2 for men and 1 in 3 for women (American Cancer Society 2015), a target risk level of 1×10^{-5} means that any increases above background would not be measurable or noticeable. The risk levels associated with baseline concentrations of arsenic are an order of magnitude greater than the acceptable risk levels. When risks due to naturally occurring substances exceed the target risk level, however, it is generally not considered to be a health concern since clean up levels are based on intentionally conservative assumptions of exposure, bioavailability and toxicity of chemicals. The incremental risk associated with the maximum predicted increase due to project-related inputs of arsenic is 1×10^{-5} which is the acceptable risk level. The spatial extent of the project-related increase of arsenic may extend as far as 10 miles from the mine site, based on the modeled estimates. The closest residential community to the mine site is Crooked Creek, located 10 miles away to the southeast. Even if there were residential uses within this area of deposition, incremental risks due to arsenic would not exceed the acceptable risk level. In the event of less intensive uses such as occasional recreational or occupational exposures to site soils, the incremental risks would be even lower. Overall, therefore, the human health risk associated with addition of project-related arsenic to soils in the vicinity of the mine site does not exceed Alaska's acceptable risk levels for contaminated sites and is considered to be insignificant in magnitude when compared to baseline. This is also consistent with EPA's interpretation of background risks and source-related risks (EPA 2002b).

Cyanide emitted from the process plant is anticipated to be primarily an air quality impact and expected to have little effect on soil quality. Cyanide is not expected to be persistent in soil due to volatilization and biodegradation (Section 3.2.3.2.4, Soils).

During the closure phase, dust is expected to be generated during reclamation activities, although the concentrations of metals in the dust would be lower than those from mine operations, as the source of the dust would be mostly from overburden and growth media with concentrations similar to baseline values (Section 3.2, Soils). Therefore, no project-related increases in concentrations of metals and other chemicals in soil would be expected.

Health effects related to soil quality are considered to be low (effect not perceptible), of low intensity (barely above background), very high duration (construction, operations and beyond), medium / localized in extent (up to 10 miles away from the mine site) and low in likelihood due to the level of conservatism inherent in risk assessment. Therefore, the impacts to human health through exposure to project-related hazardous chemicals in soil during the construction and operations phase are ranked low. Additional detail is provided in Section 3.7.2, Soils.

Exposure to Bioaccumulated Chemicals in Fish

Consumption of locally-caught fish is an important part of the diet of the affected communities. Various species of salmon are the overwhelming favorite, although other fish species such as trout are also consumed. Stakeholders have expressed concerns regarding the potential for uptake of toxic constituents into fish tissue, particularly mercury, as a result of mining activities, and the potential for impacts to human health.

Uptake of mercury into fish tissue was extensively evaluated in ARCADIS (2014) where field sampling and modeling were integrated to predict worst-case concentrations of mercury in aquatic and terrestrial environments and in fish tissue in the Crooked Creek watershed.

As summarized in ARCADIS (2014), the study focused on the extent to which the environment around the proposed project serves as a sink or source of mercury, and how increased deposition from fugitive and stack sources of mercury associated with the proposed project would affect mercury transportation and fate to plants and animals, and exposure to humans. Given the low predicted overall increase in mercury content in soil and sediment and lack of large change anticipated for methylmercury production rates, potential changes in mercury concentrations in plants, fish, and wildlife as result of the proposed project were predicted to be small. Fish consumption advice related to mercury has been developed for burbot liver and pike meat for the central Kuskokwim River area (Hamade 2014; McLaughlin and Castrodale 2014). Conservative estimates of increases in fish tissue mercury concentrations as a result of deposition of fugitive and stack sources indicated that the increase in fish tissue concentrations would be very low (on the order of 2–3 percent), which is within the range of regional background fish tissue concentrations. Because of the conservative assumptions built into the modeling and tissue concentration estimates, actual increases (if any) are expected to be less than the conservative estimates, and are not expected to result in adverse effects to aquatic life or human health or increase the level of consumption advisories. Since mercury was not predicted to cause adverse effects (ARCADIS 2014), it is unlikely that other less toxic constituents that may be released from mine site activities would pose a threat to human health.

Health effects related to bioaccumulated chemicals in fish would be considered high, if exposure were to occur. However, health effects at estimated levels are considered to be low (similar to background levels), of low intensity (concentrations in fish would be within the range of regional concentrations), of very high / long-term duration (from construction to post-closure), medium in extent (local watersheds) and low in likelihood since change in tissue levels are predicted to be at the most 2-3 percent greater than background. Therefore, the impacts to human health through exposure to project-related hazardous chemicals in fish tissue are ranked low. Additional detail is provided in ARCADIS (2014), as well as Vegetation (Section 3.10), Wetlands (Section 3.11), and Subsistence (Section 3.21).

Exposure to Bioaccumulated Chemicals in Waterfowl and Wildlife

Uptake of mercury and other constituents related to mine site activities may also occur from aquatic and terrestrial media into other types of natural resources. Stakeholder concerns have also been expressed regarding potential threats to human health based on bioaccumulation of toxic constituents into other natural resources that are consumed by subsistence and recreational harvesters in the potentially affected communities. These include consumption of fruits and berries, waterfowl, and small and large mammalian wildlife.

As noted in Sections 3.2 (Soils), 3.10 (Vegetation), and 3.21 (Subsistence), fugitive dust from the mine construction and operations phases has the potential to be deposited on berries near the mine site, which would make subsistence users wary about harvesting this resource. However, most berry picking by residents of Crooked Creek takes place in a large area away from the mine site. In Section 3.10.3, Vegetation, fugitive dust impacts to plants were rated as low to medium intensity, while Section 3.2, Soil, noted that fugitive would dust remain largely within the mine site.

As noted in Section 3.12.5, Wildlife / Birds, the standing water bodies would have varying levels of inorganic constituents, with the TSF likely to have higher concentrations of antimony, arsenic, and selenium than the pit lake. The TSF would be characterized by on-going mining activity during operations, and would be unlikely to support growth of vegetation or invertebrates that might serve as food sources for waterfowl. Without food sources and with the expected short durations of visits to the pit lakes, waterfowl are unlikely to stay long in the TSF. In all, migratory waterfowl are not expected to be at risk from ingestion of toxic water, food or sediment at the water storage features.

Species that are of interest to subsistence hunters in the EIS Analysis Area (e.g., moose, caribou, black bear) are generally not a concern for bioaccumulation of chemicals from soils and vegetation (Section 3.12.3.2.2, Wildlife). Large herbivorous mammals may be exposed to chemicals that have bioaccumulated from soil into the vegetation that forms their diet and by some incidental ingestion of soil during browsing. However, none of the chemicals associated with the project activities (primarily metals, cyanides, and organic chemicals associated with fuel oils) have high bioaccumulation potential in upland terrestrial environments and would not be expected to bioaccumulate into vegetation at high concentrations. In addition, large game mammals typically have large foraging areas and feeding on vegetation from the vicinity of the mine site would be only a minor portion of their range. Therefore, their overall dietary exposure to hazardous chemical constituents from the mine site area would likely be minor. Health risks would be low for subsistence and recreational hunters who consume meat from large game mammals that may have met a portion of their foraging needs in the vicinity of the mine site.

Health effects related to bioaccumulation of chemicals in waterfowl and wildlife are considered to be low (barely above background), of low magnitude (since change in tissue levels would be expected to be within regional background), of very high / long-term duration (from construction to post-closure), medium / local in extent (local watersheds and habitat areas) and low in likelihood since the probability of occurrence of elevated concentrations is low. Therefore, the impacts to human health through exposure to project-related hazardous chemicals in fish tissue during all project phases are ranked low. Additional detail is provided in ARCADIS (2014), as well as Vegetation (Section 3.10), Wetlands (Section 3.11), Wildlife (Section 3.12), and Subsistence (Section 3.21).

Exposure to Mercury

As described in Section 3.22.3.4.3, the mercury monitoring program using hair samples collected from residents in the project area showed that median hair mercury level found in this study (0.510 ppm) was similar to the state median level (0.46 ppm) (ADHSS 2010, as cited in NewFields 2015). The median value was almost 30 times lower than ATSDR's threshold value of 15.3 ppm, and about 10 times lower than Alaska's public health follow-up value of 5 ppm. Additionally, the communities that were downriver and closest to the former Red Devil Mine (Red Devil, Crooked Creek, and Chuathbaluk) had some of the lowest levels of the sampled communities. In this perspective, it is very unlikely that even combined exposures to mercury from multiple pathways related to the proposed project (e.g., air inhalation, consumption of fish and game), would result in mercury concentrations in people that would exceed the health guidelines.

Transportation Facilities

The CSM associated with the transportation component for Alternative 2 is illustrated in Figure 3.22-5. The sources of hazardous constituents associated with transportation facilities include diesel fuels that may be used by aircraft, barges, and trucks as they transport cargoes to and from the mine site to Angyaruaq (Jungjuk) Port site, along the Kuskokwim River to Bethel and Dutch Harbor and beyond. There may also be dusts and metals generated from non-acid-generating rock that is used for road construction. As discussed earlier, NAG and PAG may be used to construct the roads to support the mine site construction and operations. Although waste rock stockpiles are tested for hazardous chemicals, an acidic environment may cause trace metals to leach from the waste rock and enter the surrounding environment as run-off or in fugitive dust. Section 3.2.3.2.4, Soils, discusses the acid and base characteristics of the waste rock. The carbonate neutralization potential (NP) of the ore is assumed to be similar to that of PAG7 waste rock or 4.6 t $CaCO_3$ / kt. In contrast, the tonnage-weighted average of all waste rock types would have an acid producing (AP) of 11.0 t $CaCO_3$ / kt and an NP of 60.5 t $CaCO_3$ / kt. Applying the percentage of ore in the dust to these values, the overall net NP of the dust would be 46 t $CaCO_3$ / kt, and the overall NP to AP ratio of the dust would be 4.7, meaning that the dust has the capacity to neutralize 4.7 times more acid than it can generate. In other words, the large excess of NP in the waste rock, which would comprise the majority (96.5 percent) of the dust, would be more than sufficient to counteract the AP of the ore component, and the net effect of dust deposition would be a minor increase in both the buffering capacity and the alkalinity of soils in the vicinity of the mine site. The neutralization of the acid minimizes the likelihood of hazardous metals from leaching from the waste rock into the surrounding environment.

Air Quality

Impacts to human health related to air quality would be low, the same as identified for the mine site.

Surface Water Quality

The transportation facilities as proposed in Alternative 2 are expected to have minor effects on water quality. Surface water quality could be temporarily and locally affected during construction. During operations, barging in shallow sections may have local effects on sediment and turbidity. Within these two phases, measurable groundwater effects are not expected.

Impacts to human health based on surface water quality are not expected to be a concern because there are no surface water intakes in the area of potential impact and therefore exposure pathways are incomplete. As noted in Section 3.7.3.2.2 (Water Quality), under Alternative 2, effects to surface water quality would be considered low intensity (e.g., occasional barge–induced suspended sediment, or erosion effects at construction sites), due to high natural conditions and / or planned mitigation measures designed to limit erosion effects.

Potential impacts could include inputs of arsenic, selenium, antimony, and possibly other constituents of concern, to area surface water resources, including Jungjuk Creek. In order to mitigate potential impacts to surface water resources that could result from materials stockpiles, Donlin Gold would test materials for the potential to act as sources of constituents of concern prior to stockpiling materials. Materials that could act as sources of contamination would not be used for road construction, and other material sources would be identified (Section 3.7.3.2.2, Water Quality). The geographic distribution of such impacts would be limited to areas in the immediate vicinity of roads and road construction material stockpiles. Such impacts would be considered medium / local in geographic extent due to the discrete areas of the EIS Analysis Area that would be impacted. The duration of such impacts would be considered very high / long-term because the impacts would be likely to persist for the duration of the project, and water quality would return to baseline levels following the completion of mining activities., Adverse effects on human health would not be expected; surface water from these locations is not used as a potable water source. Impacts to human health related to surface water quality would be low, the same as for the mine site component.

Groundwater Quality

Nine villages are located between Bethel and Crooked Creek along the Kuskokwim River and adjacent sloughs (Kwethluk, Akiachak, Akiak, Tuluksak, Lower Kalskag, Upper Kalskag, Aniak, Chuathbaluk, and Napaimute). Each village except Napaimute has records of one or more wells drilled for water supply. While most well records are for public water systems, there are also some records of privately owned wells. Bethel has the most numerous wells, with approximately 17 known public water systems served by wells, although a few are inactive (Section 3.6.1.5.2, Groundwater Hydrology). Impacts to human health based on groundwater

water quality are not expected to be a concern due to the distance from the area of impact, and therefore exposure pathways are considered incomplete.

The construction of transportation facilities at Dutch Harbor, Bethel, and Angyaruaq (Jungjuk) ports proposed under Alternative 2 are not expected to have measurable effects on groundwater quality. It is possible that placement of sheet pile associated with the construction of transportation terminals at Bethel and Angyaruaq (Jungjuk) ports would have localized impacts on the rates of exchange between surface water and shallow groundwater deposits along the banks of the Kuskokwim River (see Section 3.7.2.2.2, Water Quality). These impacts would be limited to the areas immediately adjacent to the terminal facilities, and the effects on the composition of the groundwater and availability for beneficial uses would be negligible. The use of groundwater for drinking water supplies at the Angyaruaq (Jungjuk) Port would not adversely affect groundwater quality.

Impacts to human health based on the hazardous constituents aspects of groundwater quality during all project phases would be low, the same as discussed for the mine site component.

Soil Quality

Exposure pathways related to hazardous constituents in soils for the transportation component are expected to be incomplete for residents since the footprint of the transportation components would not be located in residential and commercial/industrial areas. In Dutch Harbor and Bethel, the new infrastructure is expected to be located in previously disturbed port areas. Exposure to dust during construction would be controlled and abated through best management practices. Potential for exposure to hazardous constituents would be through deposition of airborne dust and chemicals that may settle out on soil surfaces in the general vicinity of the transportation systems and subsequent contact with soils by community members engaged in subsistence activities. This exposure was evaluated in Section 3.2 (Soil), 3.8 (Air Quality), and 3.21 (Subsistence).

Section 3.2 describes dust mitigation practices through all phases of the project components such as minimized transport distances of soils, water, and surfactants used on haul roads, fugitive dust baghouses to control emissions at transfer points, and steel enclosures for coarse ore.

Section 3.8 notes that emission of mercury is not a concern for the transportation facilities since ore would not be handled. Fugitive dust is expected due to heavy equipment during construction (Table 3.8-26, Air Quality). During operations fugitive dust is expected to be localized to the transport roads (Table 3.8-27, Air Quality) and is estimated to be below permit thresholds. There would be no noted impacts to air quality during closure and reclamation.

Section 3.21, Subsistence, notes fugitive dust deposits on plants used for subsistence as one of three impact types for transportation facilities. Fugitive dust is noted as a by-product of construction and operations but its effects are local and mitigated by dust control measures. The effect of fugitive dust on human health for transportation facilities during all project phases would be low, the same as discussed for the mine site component.

Exposure to Bioaccumulated Chemicals in Fish

The exposure pathway related to consumption of fish that may take up hazardous constituents related to the transportation components is considered complete, primarily for the creeks in the vicinity of the transportation components and the Kuskokwim River. The sources of chemicals associated with the transportation component are primarily diesel fuels as well as other chemicals associated with the types of cargo being transported. Beyond Bethel, the contribution from these non-point sources of hazardous chemicals associated with the project to fish tissue concentrations would be too uncertain to quantify.

The impact on fishing has been evaluated in Section 3.16, Recreation, and Section 3.21.6.3.2, Subsistence. The petroleum constituents associated with fuels that may be taken up into fish and shellfish typically include polyaromatic hydrocarbons (PAHs). PAHs are generally metabolized in fish tissue and generally do not persist long enough to accumulate to significant levels in fish tissue (NOAA undated). PAHs may adversely affect aquatic and benthic macroinvertebrate communities that are the prey base for many fish species. If such uptake occurs, the quality of the fish diets may be affected. Overall, the potential for bioaccumulation of adverse PAHs in fish would be considered low.

Health effects related to the bioaccumulation of hazardous constituents in fish during all phases of the transportation component are considered to be low, the same as discussed for the mine site.

Exposure to Bioaccumulated Chemicals in Waterfowl and Wildlife

Similar to the aquatic environment, the chemicals that may be distributed from the transportation facilities into the upland environment are most likely associated with diesel fuels and aviation fuels and the associated cargo. The majority of the chemicals would be volatile petroleum constituents and PAHs with low potential for bioaccumulation into vegetation or upland game.

The impact on subsistence hunting and berry picking in general has been evaluated in Section 3.16, Recreation, and Section 3.21.6.3.2, Subsistence. Overall, the potential for bioaccumulation of hazardous constituents in vegetation, waterfowl, and wildlife tissue is considered low; the same as discussed for the mine site.

Pipeline

The CSM associated with the pipeline component for Alternative 2 is illustrated on Figure 3.22-6. The 315-mile pipeline would be mostly buried within the ROW, with occasional above-ground facilities, such as the compressor station, and two active seismic fault crossings. Almost the entire length of the pipeline would be located in remote areas, distant from residential communities or other areas of frequent human use. Therefore, exposure to pipeline-related activities would be incomplete for almost all media. It is noted that portions of the proposed pipeline ROW intersect with or are collocated with the Iditarod National Historic Trail. This collocation is not expected to introduce a human health concern due to the nature of the proposed facilities. Human health effects are discussed for air quality and groundwater quality, as related to the pipeline component.

The sources of hazardous constituents associated with transportation pipeline facilities include construction materials that may be used during the construction of the pipeline, and fuel oils and lubricants that may be used at the valve and maintenance stations during operations and closure/post-closure. The pipeline components (compressor station, metering stations, mainline block valves, pipeline) would emit neither criteria pollutants nor substantial quantities of HAPs. However, there would be minor fugitive GHG emissions due to leaks from the compressor station, pipeline segments, valves, and fittings (emissions are presented for the three phases in

Table 3.8-30 and Table 3.8-31, in Section 3.8, Air Quality). In addition, there would be some project-related maintenance activity along the pipeline such as vehicle and helicopter traffic.

Air Quality

Direct impacts to air quality from the pipeline component would be caused by air emissions from fugitive and mobile sources. As described in Section 3.8, Air Quality, no permit or reporting threshold for air quality would be exceeded in any project phase for the pipeline component. Although some open burning may occur in remote areas, air pollutant emissions from such open burning is expected to be minimal and would be conducted in accordance with an open burn approval as required by the ADEC (Section 3.8.3.3.3).

As discussed for the mine site and transportation components, effects are considered to be localized, and AAQS would not be exceeded. Therefore, the air quality effects are considered to be low. No adverse effects on human health are expected with regard to hazardous constituents in air during all phases of the pipeline component.

Groundwater Quality

For some areas along the pipeline route, the groundwater depth may fall within the pipeline burial depths. Mitigation measures such as trench plugs would serve to isolate the pipeline from the groundwater and therefore prevent the potential for contamination of groundwater (Section 3.6.2.2.3, Groundwater Hydrology). As discussed for the mine site and transportation components, effects are considered to be low. No adverse effects on human health are expected with regard to hazardous constituents in groundwater during all phases of the pipeline component.

Alternative 2, HEC 3 Impact Summary: Exposure to Potentially Hazardous Materials

The summary impact level for exposure to potentially hazardous materials is low for all project components and all project phases.

Table 3.22-20: Summary of HEC 3 Impacts: Exposure to Potentially Hazardous Materials

Potential Impact	Project Component	Project Phase	Negative/ Positive	Health Effect	Magnitude/ Intensity	Duration	Geographic Extent	Severity Ranking	Likelihood Rating	Impact Rating	Impact Level
Air quality (mercury, PM, and VOCs)	All components: Mine Site, Transportation Facilities, Natural Gas Pipeline	Construction	–	Medium (1)	Low (0)	High (2)	Medium (1) Local	**4**	10-33%	*	**Low**
		Operations and Maintenance		Medium (1)	Low (0)	Very high (3)	Medium (1) Local	**5**	10-33%	*	**Low**
		Closure, Reclamation, and Monitoring		Medium (1)	Low (0)	Very high (3)	Medium (1) Local	**5**	10-33%	*	**Low**
Surface water quality	Mine Site and Transportation Facilities	Construction	–	Low (0)	Low (0)	Medium (temporary) (2)	Medium (1) Local	**3**	10-33%	*	**Low**
		Operations and Maintenance		Low (0)	Low (0)	Very High (3)	Medium (1) Local	**4**	10-33%	*	**Low**
		Closure, Reclamation, and Monitoring		Low (0)	Low (0)	Very High (3)	Medium (1) Local	**4**	10-33%	*	**Low**
	Natural Gas Pipeline	All Phases	–	Almost the entire length of the pipeline is located in remote areas that are distant from residential communities or other areas of frequent human use. Therefore, exposure to pipeline-related activities would be incomplete for almost all media.							
Groundwater quality	All components: Mine Site, Transportation Facilities, Natural Gas Pipeline	Construction	–	Low (0)	Low (0)	Very High (3) (M,P) Medium (2) (T)	Medium (1) Local	4 (M, P) 3 (T)	10-33% (M,T) <1% (P)	*	**Low**
		Operations and Maintenance		Low (0)	Low (0)		Medium (1) Local	4 (M, P) 3 (T)	10-33% (M,T) 1-10% (P)	*	**Low**
		Closure, Reclamation, and Monitoring		Low (0)	Low (0)		Medium (1) Local	4 (M, P) 3 (T)	10-33% (M,T) 1-10% (P)	*	**Low**
Soil quality	Mine Site, Transportation Facilities	Construction	–	Low (0)	Low (0)	Very High (3)	Medium (1) Local	**4**	10-33%	*	**Low**
		Operations and Maintenance		Low (0)	Low (0)	Very High (3)	Medium (1) Local	**4**	10-33%	*	**Low**
		Closure, Reclamation, and Monitoring		Low (0)	Low (0)	Very High (3)	Medium (1) Local	**4**	10-33%	*	**Low**
	Natural Gas Pipeline	All Phases	–	Almost the entire length of the pipeline is located in remote areas that are distant from residential communities or other areas of frequent human use. Therefore, exposure to pipeline-related activities would be incomplete for almost all media.							
Bioaccumulated Chemicals in Fish	Mine Site, Transportation Facilities	Construction	–	Low (0)	Low (0)	Very High (3)	Medium (1) Local	**4**	10-33%	*	**Low**
		Operations and Maintenance		Low (0)	Low (0)	Very High (3)		**4**	10-33%	*	**Low**
		Closure, Reclamation, and Monitoring		Low (0)	Low (0)	Very High (3)		**4**	10-33%	*	**Low**
	Natural Gas Pipeline	All Phases	–	Almost the entire length of the pipeline is located in remote areas that are distant from residential communities or other areas of frequent human use. Therefore, exposure to pipeline-related activities would be incomplete for almost all media.							
Bioaccumulated Chemicals in Waterfowl and Wildlife	Mine Site, Transportation Facilities	Construction	–	Low (0)	Low (0)	Very High (3)	Medium (1) Local	**4**	10-33% (M) 1-10% (T)	*	**Low**
		Operations and Maintenance		Low (0)	Low (0)	Very High (3)		**4**	10-33% (M) 1-10% (T)	*	**Low**
		Closure, Reclamation, and Monitoring		Low (0)	Low (0)	Very High (3)		**4**	10-33% (M) 1-10% (T)	*	**Low**
	Natural Gas Pipeline	All Phases	–	Almost the entire length of the pipeline is located in remote areas that are distant from residential communities or other areas of frequent human use. Therefore, exposure to pipeline-related activities would be incomplete for almost all media.							

Notes:

M = Mine Site T = Transportation Facilities P = Natural Gas Pipeline

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3.22.4.2.4 HEC 4: FOOD, NUTRITION, AND SUBSISTENCE ACTIVITY

The following subsections evaluate potential benefits due to decreases in regional food costs and increases in food security that could occur due to increased economic opportunities for the potentially affected communities. The potential impact due to decreases in access to and/or quantity of subsistence resources is also evaluated. Table 3.22-21 summarizes the potential impact levels for food, nutrition, and subsistence activity, including the potential health effect consequence, magnitude (intensity), duration, and geographic extent of the impact, and likelihood of the impact occurring.

Decrease in Region Food Costs

Increases in economic opportunities could result in increases in the median household incomes of the populations located in the potentially affected communities. A metric for comparing relative food costs is to compare the percent of the median household income to purchase the same food products annually. This comparison shows that to get the same food, 9.2 percent of the household median income for Anchorage is equivalent to 24 percent of the median household income for the Bethel Census Area. The rate rises to 14.7 percent for Bethel, 53.6 percent for Upper Kalskag, and as high as 125.0 percent for Stony River (USCB 2000; ADOL 2005; UAF 2011, all as cited in NewFields 2015). Therefore, decreases in food costs for these households could affect a substantial portion of the EIS Analysis Area.

The potential impact (beneficial) to human health due to decreased regional food costs for the EIS Analysis Area would be medium for the construction and closure phases and high for the operations phase. Increases in household income or employment rates could influence the affordability of goods and services (including food). The health effect would be high (effect is moderately perceptible) for the construction and operations phases and low for the closure phase. The intensity of this benefit would be medium (measureable/noticeable change). The geographic extent of this potential benefit would be medium/local because it would be limited to households that would benefit from project-related economic opportunities. The duration of this benefit would correlate with the duration of the three project phases; therefore, the construction phase (3-4 years) is rated high, and the operations and maintenance (27 years) and closure, reclamation, and monitoring (>50 years) phases are rated very high. The likelihood of decreased regional food costs is considered likely (66-90 percent) due to the expected improved economic opportunities, including increases in household incomes and employment rates.

Increases in Diet Composition and Food Security

Increases in economic opportunities could result in an increase in the median household incomes of the populations located in the EIS Analysis Area, resulting in an increase in food security. Based on U.S. Department of Agriculture definitions for food security, many of the small communities are below food security (ADF&G 2011, as cited in NewFields 2015). The percentage of low and very low food secure-households in the EIS Analysis Area ranges from 5 to 25 percent of the communities in the bethel Census Area (Table 3.22-8). Although there would be some uncertainty in assuming that increased incomes due to employment or ancillary sales and taxes would be channeled directly to food-insecure households, it is likely that at least some portion of the economic benefits would improve food security. While not all of the increased income may be spent on food, at least some portion would likely be spent on food, especially in the food-insecure households.

The potential benefit of increased food security for communities in the EIS Analysis Area would be medium for the construction and closure project phases and high for the operations phase. Increases in household incomes or employment rates could improve food security. For the construction and operations phases, the health effect is anticipated to be high (effect is moderately perceptible), and low for the closure phase. The intensity of this benefit would be medium (measureable / noticeable change). The geographic extent of this potential benefit would be medium / local because it would be most evident in food-insecure households that would benefit from project-related economic opportunities. The duration of this benefit would be high for the construction phase (3-4 years) and very high for the operations and maintenance (27 years) and closure, reclamation, and monitoring (>50 years) phases. The likelihood of increases in food security in the EIS Analysis Area is considered likely (66-90 percent) due to the expected improved economic opportunities, including increases in household incomes, and employment rates.

<u>Access to and Quantity of Subsistence Resources</u>

Changes in access to and / or quantity of subsistence resources (possibly a scarcity of subsistence food options) in the region could occur as a result of changes in employment (population outward migration), the fly-in, fly-out work rotations of the workforce, and overlap of subsistence resources and subsistence uses in the vicinity of project components. Subsistence activity is vital in the region, especially for the small Kuskokwim River communities, where unemployment rates are high, household incomes are low, and food cost is high. Subsistence foods are commonly used and are widely recognized as healthier than market food options. Input from scoping meetings and tribal cooperating agencies stated the importance of the subsistence way of life and Alaska Native cultural traditions (Section 3.21, Subsistence).

Subsistence and commercial fishing and other uses of the river could potentially be affected by project-related barge traffic. The effect of the project on subsistence activities suggests that net positive benefits may be realized since increased incomes would make procurement of hunting and fishing equipment more affordable and the actual area of impact related to project activities is limited to a few square miles within the context of a much larger area of available natural resources. By maintaining their connections to subsistence activities, both the social and dietary health benefits of subsistence lifestyles are realized.

The potential impact of decreased access to and / or quantity of subsistence resources for the potentially affected communities would be low for the project phases. Residents living in the central Kuskokwim River communities closest to the mine, particularly Crooked Creek, could be impacted by reduced access to subsistence resources near the mine site that would be closed to public use for safety purposes. Subsistence users may perceive that waterfowl potentially accessing the tailings pond and the pit lake could be contaminated, but this is not expected to be a health concern (Section 3.22.3.4.3). Therefore, the health effect would be low (effects not perceptible).

The intensity of the impact would be medium (those affected would be able to adapt to the impacts) because the residents of Crooked Creek historically have relied only in small part upon subsistence resources from the mine site. A medium intensity effect would also be anticipated for residents that rely on migratory waterfowl that may pass through the mine site (based on residents' perception that waterfowl may be contaminated and may avoid consumption). The intensity also reflects the greater exposure to the region and increased access for airborne hunters and trappers at Farewell Airstrip.

The geographic extent of this potential impact would be medium because a limited number of households would be affected, primarily among the Kuskokwim River communities. The duration of this impact would be high for the construction phase (3-4 years) and very high for the operations and maintenance (27 years) and closure, reclamation, and monitoring (>50 years) phases.

The likelihood of this impact occurring is considered unlikely (10-33 percent) for all phases of the mine, the operations phase of the natural gas pipeline, and the closure phase of the transportation and natural gas pipeline components. The overlap of the mine site with local subsistence resources is small and the potential for contamination of migratory waterfowl is low. Water transportation along the Kuskokwim River and activities in the vicinity of the pipeline would be similar to or near baseline during the closure phase.

The likelihood of this impact occurring is considered likely (66-90 percent) for the construction phase of the transportation and natural gas pipeline components. Water transportation is expected to be via the Kuskokwim River, which is also the principal water body in the region that supports subsistence and commercial fishing. Activity along pipeline corridor will be at a peak during the construction phase. This likelihood continues through the operations phase of the transportation component.

Alternative 2, HEC 4 Impact Summary: Food, Nutrition, and Subsistence Activity

Alternative 2 would generate medium to high potential health benefits due to decreased regional food costs and increased food security (resulting from potential increases in median household incomes). This alternative would also generate low impacts (adverse) due to a potential for decreased access to and / or quantity of subsistence resources.

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Table 3.22-21: Summary of HEC 4 Impacts: Food, Nutrition, and Subsistence Activity

Potential Impact	Project Component	Project Phase	Negative/ Positive	Health Effect	Magnitude/ Intensity	Duration	Geographic Extent	Severity Ranking	Likelihood Rating	Impact Rating	Impact Level
Decrease in region food costs (expressed as a % of median household income)	All components: Mine Site, Transportation Facilities, Natural Gas Pipeline	Construction	+	High (2)	Medium (1)	High (2)	Medium (1), limited to households that benefit from economic opportunities	**6**	66-90%	**	**Medium**
		Operations and Maintenance		High (2)	Medium (1)	Very high (3)		**7**	66-90%	***	**High**
		Closure, Reclamation, and Monitoring		Low (0)	Medium (1)	Very high (3)		**5**	66-90%	**	**Medium**
Increase in diet composition and food security	All components: Mine Site, Transportation Facilities, Natural Gas Pipeline	Construction	+	High (2)	Medium (1)	High (2)	Medium (1), limited to households that benefit from economic opportunities	**6**	66-90%	**	**Medium**
		Operations and Maintenance		High (2)	Medium (1)	Very high (3)		**7**	66-90%	***	**High**
		Closure, Reclamation, and Monitoring		Low (0)	Medium (1)	Very high (3)		**5**	66-90%	**	**Medium**
Access to and quantity of subsistence resources	All components: Mine Site, Transportation Facilities, Natural Gas Pipeline	Construction	–	Low (0)	Medium (1)	High (2)	Medium (1), limited number of households	**4**	10-33%	*	**Low**
		Operations and Maintenance		Low (0)	Medium (1)	Very high (3)		**5**	10-33%	*	**Low**
		Closure, Reclamation, and Monitoring		Low (0)	Medium (1)	Very high (3)		**5**	10-33%	*	**Low**

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3.22.4.2.5 HEC 5: INFECTIOUS DISEASES

The following subsections present the evaluation of the potential impacts of increases in rates of infectious diseases, including sexually-transmitted infections (STIs) (e.g., gonorrhea, chlamydia, Hepatitis C, and HIV), respiratory diseases (e.g., influenza and pneumonia), foodborne illness (e.g., salmonella and E. Coli), and zoonotic diseases (disease that is passed between animals and humans). Table 3.22-22 summarizes the potential impact levels for infectious diseases, including the potential health effect consequence, magnitude (intensity), duration, and geographic extent of the impact, and likelihood of the impact occurring.

<u>Increases in Sexually-Transmitted Infection Rates</u>

Increases in STI rates could occur due to employment of workers from outside the region and/or the rotation of the workforce during the project phases. STI rates are reported as high for the populations in the EIS Analysis Area, and account for 89.4 percent of reported infectious disease cases from 2007 to 2008 for Alaska Natives (University of Wisconsin 2011; ADHSS 2011, both as cited in NewFields 2015). Chlamydia trachomatis was reported as 10 times more common than the next STI (gonorrhea) (University of Wisconsin 2011; ADHSS 2011, both as cited in NewFields 2015). In 2011, the chlamydia rate in the Bethel Census Area was 2,321 cases per 100,000 population compared to the state rate of 711 cases per 100,000 population, with both rates increasing from previous years (University of Wisconsin 2011, as cited in NewFields 2015). Hepatitis C may be transmitted as an STI but also through other means such as blood transfusions.

For all components and project phases, the health effect would be medium (minor health injury). The intensity of this impact would be medium because those affected would be expected to adapt to this impact by obtaining medical care. The geographic extent of this impact would be medium because this impact would be limited to infected individuals and their immediate partners.

The duration of this impact would correlate with the duration of the three project phases; therefore, the construction phase (3-4 years) is rated high, and the operations and maintenance (27 years) and closure, reclamation, and monitoring (>50 years) phases are rated very high. Because the project would use individuals primarily from the region for the workforce (i.e., there would not be a major influx of workers from outside the region) and statewide STI rates are lower than for communities located in the EIS Analysis Area, it is expected that STI rates would not show a discernable change; hence, the likelihood of increased STI rates is considered as likely as not (33-66 percent) for the construction and operations phases of the mine, but unlikely (10-33 percent) for the operations phase of the transportation facilities and the pipeline, as well as for the closure phase due to the smaller workforce required for those components and phases.

The potential impact of increases in STI rates for the potentially affected communities would be medium to low. The construction and operations phases would have potential for medium impact, but the closure phase is estimated to have a low rating.

Increases in Infectious (Respiratory) Diseases

Increases in infectious disease rates could occur due to employment of workers from outside the region and/or the rotation of the workforce during the project phases. Pneumonia, septicemia and viral hepatitis were the top three causes of death due to infectious diseases (ADHSS 2007-2014, as cited in NewFields, 2015). No influenza deaths were reported during the same time period (ADHSS 2007-2014, as cited in NewFields 2015). Age-adjusted rates of death from communicable diseases have been consistently higher than those experienced in the State of Alaska since 2000 (ADHSS 2007-2014, as cited in NewFields 2015).

Impacts to human health due to infectious diseases would be medium to low, the same as discussed for sexually transmitted diseases. The medium geographic extent would be limited to infected individuals, their households, and immediate neighbors and colleagues.

Increases in Rates of Foodborne Illnesses and Zoonotic Diseases

Increases in rates of foodborne illnesses and zoonotic diseases could occur due to improper food handling/catering services and food disposal (harboring wildlife) at the base camps during the project phases. The potential for increased rates of foodborne illnesses and zoonotic diseases due to improper food handling/catering services and food disposal (harboring wildlife) would be expected to impact primarily the local communities located near the project components.

The potential for increases in rates of foodborne illnesses and zoonotic diseases is greatest in base camps or workforce housing, which would occur at the mine site component and in the construction phase for other components. For all project phases, the health effect would be medium (minor health injury). The intensity of this impact would be medium because those affected would be expected to easily adapt to this impact. The geographic extent of this impact would be low because this impact would be limited to individual cases. The duration of this impact would be high for the construction phase (3-4 years) and very high for the operations and maintenance (27 years) and closure, reclamation, and monitoring (>50 years) phases. The likelihood of this impact occurring is unlikely (10-33 percent) because the base camps would have safe food handling and disposal protocols in place to manage the food handling and catering services that would be provided for the project workforce. Inert, general mine refuse (e.g., packaging, non-recyclable empty containers, non-putrescible refuse) would be placed directly into permitted on-site landfill trenches, and solid waste that contains organic matter (e.g. food scraps, paper, cardboard and wood scraps) would be incinerated in a burn pit or incinerator. The potential impact of increases in rates of foodborne illnesses and zoonotic diseases would be low for all project phases.

Alternative 2, HEC 5 Impact Summary: Infectious Diseases

The summary impact for increases in rates of infectious (communicable) diseases (e.g., STIs, influenza, pneumonia, and foodborne illnesses) is rated medium to low for Alternative 2.

Table 3.22-22: Summary of HEC 5 Impacts: Infectious Diseases

Potential Impact	Project Component	Project Phase	Negative/ Positive	Health Effect	Magnitude/ Intensity	Duration	Geographic Extent	Severity Ranking	Likelihood Rating	Impact Rating	Impact Level
Increase in sexually-transmitted infection rates (including gonorrhea, chlamydia, Hepatitis C, and HIV)	All components: Mine Site, Transportation Facilities, Natural Gas Pipeline	Construction	–	Medium (1)	Medium (1)	High (2)	Medium (1), limited to infected individuals and their partners	**5**	33-66%	**	**Medium**
		Operations and Maintenance		Medium (1)	Medium (1)	Very high (3)	Medium (1), limited to infected individuals and their partners	**6**	33-66% (M) 10-33% (T,P)	** (M) * (T, P)	**Medium (M) Low (T,P)**
		Closure, Reclamation, and Monitoring		Medium (1)	Medium (1)	Very high (3)	Medium (1), limited to infected individuals and their partners	**6**	10-33%	*	**Low**
Increase in infectious (respiratory) disease morbidity and mortality rates (e.g., influenza and pneumonia)	All components: Mine Site, Transportation Facilities, Natural Gas Pipeline	Construction	–	Medium (1)	Medium (1)	High (2)	Medium (1), limited to infected individuals and their households/ neighbors	**5**	33-66%	**	**Medium**
		Operations and Maintenance		Medium (1)	Medium (1)	Very high (3)	Medium (1), limited to infected individuals and their households/ neighbors	**6**	33-66% (M) 10-33% (T,P)	** (M) * (T, P)	**Medium (M) Low (T,P)**
		Closure, Reclamation, and Monitoring		Medium (1)	Medium (1)	Very high (3)	Medium (1), limited to infected individuals and their households/ neighbors	**6**	10-33%	*	**Low**
Increase in rates of foodborne illness and zoonotic diseases	All components: Mine Site, Transportation Facilities, Natural Gas Pipeline	Construction	–	Medium (1)	Medium (1)	High (2)	Low (0), limited to individual cases	**4**	10-33%	*	**Low**
		Operations and Maintenance		Medium (1)	Medium (1)	Very high (3)	Low (0), limited to individual cases	**5**	10-33%	*	**Low**
		Closure, Reclamation, and Monitoring		Medium (1)	Medium (1)	Very high (3)	Low (0), limited to individual cases	**5**	10-33%	*	**Low**

Notes:

M = Mine Site T = Transportation Facilities P = Natural Gas Pipeline

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3.22.4.2.6 HEC 6: WATER AND SANITATION

The section presents the evaluation of the potential impacts of increases in morbidity and mortality rates due to the availability and quality of water and sanitation services. Table 3.22-23 summarizes the potential impact levels, including the potential health effect consequence, magnitude (intensity), duration, and geographic extent of the impact, and likelihood of the impact occurring.

Increases in Morbidity and Mortality Rates due to the Availability and Quality of Water and Sanitation Services

Increases in mortality and morbidity rates could occur due to overwhelming the availability and quality of water and sanitation services. Key preventable risk factors for the spread of infectious diseases are the lack of clean running water and proper sewage disposal, which are prevalent in rural Alaska (NewFields 2015). As of 2008, the YKHC had water and sanitation service for 58 percent of their communities. Crooked Creek, Red Devil, and Stony River lack any residential water and sewer services. The other communities are served by central wells and a mix of central sewage plumbing, septic systems, honey buckets, and outhouses; smaller towns have community washeterias for laundry and bathing (NewFields 2015).

Water and sanitation services would be associated with base camps or workforce housing, which would occur at the mine site component and in the construction phase for other components. For all project phases, the health effect would be medium (minor health injury). The intensity of this impact would be medium because those affected would be expected to easily adapt to this impact. The geographic extent of this impact would be low because this impact would be limited to individual cases. The duration of this impact would be high for the construction phase (3-4 years) and very high for the operations and maintenance (27 years) and closure, reclamation, and monitoring (>50 years) phases. Since Donlin Gold would provide water and sanitation services at the base camps for the workforce for the three project phases (Section 2.3.2.1.7), the likelihood of affecting the availability and quality of water and sanitation services of communities located near the proposed project is considered unlikely (10-33 percent). The potential impact of increases in mortality and morbidity rates due to change in the availability and quality of water and sanitation services would be low for the potentially affected communities for all project phases.

Alternative 2, HEC 6 Impact Summary: Water and Sanitation

The summary impact level for increases in morbidity and mortality rates due to changes in the availability and quality of water and sanitation services is low for Alternative 2. It is unlikely that water and sanitation services of communities located near the proposed project would be affected.

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Table 3.22-23: Summary of HEC 6 Impacts: Water and Sanitation

Potential Impact	Project Component	Project Phase	Negative/ Positive	Health Effect	Magnitude/ Intensity	Duration	Geographic Extent	Severity Ranking	Likelihood Rating	Impact Rating	Impact Level
Increase in morbidity and mortality rates due to the availability and quality of water and sanitation facilities	All components: Mine Site, Transportation Facilities, Natural Gas Pipeline	Construction	–	Medium (1)	Medium (1)	High (2)	Low (0), limited to individual cases	**4**	10-33%	*	**Low**
		Operations and Maintenance		Medium (1)	Medium (1)	Very high (3)	Low (0), limited to individual cases	**5**	10-33%	*	**Low**
		Closure, Reclamation, and Monitoring		Medium (1)	Medium (1)	Very high (3)	Low (0), limited to individual cases	**5**	10-33%	*	**Low**

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3.22.4.2.7 HEC 7: NON-COMMUNICABLE AND CHRONIC DISEASE

Emissions to air could occur during the construction, operation, and closure phases for all components, resulting in increases in exposure to hazardous air constituents. The section presents the evaluation of the potential impacts of increases in cancer, respiratory, and cardiovascular morbidity and mortality rates. Table 3.22-24 summarizes the potential impact levels for non-communicable and chronic diseases, including the potential health effect consequence, magnitude (intensity), duration, and geographic extent of the impact, and likelihood of the impact occurring.

Increases in Cancer, Respiratory, and Cardiovascular Morbidity and Mortality Rates

There is reported correlation between increased exposure to hazardous air constituents and increases in the morbidity and mortality rates for cancer (IARC 2013; Hystad et al. 2013; Kota et al. 2011; Turner et al. 2011), chronic lower respiratory diseases (CLRD) (Koren 1995; Schwela 2000; Chen 2008; Kota et al. 2011), and cardiovascular diseases (e.g., particulate matter, PM) (Atkinson et al. 2013; Gan et al. 2010 and 2011; Yorifuji et al. 2010).

Based on the modeled results, emissions during the project phases (construction; operations and maintenance; and closure, reclamation and monitoring) are not expected to cause an exceedance of any air quality standards (Section 3.8, Air Quality). In addition, mitigation measures and required best management practices, such as abatement and dust suppression, would be expected to further reduce emissions.

Health effects related to cancer, respiratory, and cardiovascular morbidity and mortality would be considered high (moderate injury that may require intervention), if exposure were to occur. However, health effects and the intensity of the impact at estimated levels of exposure are considered to be low (similar to background levels). The geographic extent of this impact would be rated high because the communities within the vicinity of the Project Area could be potentially affected. The duration of this impact would be high for the construction phase (3-4 years) and very high for the operations and maintenance (27 years) and closure, reclamation, and monitoring (>50 years) phases. Based on the air quality modeling results (Section 3.8, Air Quality), the likelihood of increased cancer, respiratory, and cardiovascular morbidity and mortality rates due to increased exposure to hazardous air pollutants is considered unlikely (10-33 percent). The summary impact level for increased morbidity and mortality rates for cancer, respiratory, and cardiovascular diseases is rated low for Alternative 2.

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Table 3.22-24: Summary of HEC 7 Impacts: Non-communicable and Chronic Diseases

Potential Impact	Project Component	Project Phase	Negative/ Positive	Health Effect	Magnitude/ Intensity	Duration	Geographic Extent	Severity Ranking	Likelihood Rating	Impact Rating	Impact Level
Increase in cancer, respiratory, and cardiovascular morbidity and mortality rates	All components: Mine Site, Transportation Facilities, Natural Gas Pipeline	Construction	–	Low (0)	Low (0)	High (2)	High (2)	**4**	10-33%	*	**Low**
		Operations and Maintenance		Low (0)	Low (0)	Very high (3)	High (2)	**5**	10-33%	**	**Low**
		Closure, Reclamation, and Monitoring		Low (0)	Low (0)	Very high (3)	High (2)	**5**	10-33%	**	**Low**

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3.22.4.2.8 HEC 8: HEALTH SERVICES INFRASTRUCTURE AND CAPACITY

Access to health services is important for achieving health equity and increasing the quality of life for all individuals. The level of access to health services can impact life expectancy, mortality, and morbidity rates; early detection and treatment of health conditions, and control of infectious diseases (access to vaccines). The following subsections present the evaluation of the potential impacts due to decreased access to healthcare under routine conditions and emergency situations that could overwhelm local and regional healthcare capacities. Table 3.22-25 summarizes the potential impact levels for health services infrastructure and capacity, including the potential health effect consequence, magnitude (intensity), duration, and geographic extent of the impact, and likelihood of the impact occurring.

<u>Access to Routine Healthcare</u>

The workforce estimated for Alternative 2 has the potential to impact access to routine healthcare. Several entities provide healthcare services in the EIS Analysis Area. The YKHC manages a comprehensive healthcare system on behalf of 58 federally recognized tribes for 50 rural communities in southwest Alaska (NewFields 2015). The ANMC is the statewide referral center for specialty care for Alaska Natives. YKDRH, the primary hospital for the YKHC region, is a 50-bed hospital located in Bethel that provides dental and optical services, mental health services, substance abuse counseling and treatment, health promotion and disease prevention programs, and environmental health services (NewFields 2015). The ANMC and YKDRH support a system of small local clinics throughout the region (YKHC undated, as cited in NewFields 2015).

Hospitals and/or local clinics are available for the communities along the proposed pipeline route. Chief Andrew Isaac Health Center (CAIHC), located adjacent to Fairbanks Memorial Hospital, is the major Alaska Native health facility for the Upper Kuskokwim portion of the region associated with the pipeline corridor (NewFields 2015). The McGrath Health Center is a sub-regional Emergency Care Center that also provides support for Community Health Aides in surrounding communities, arranges medical evacuations as necessary, and provides routine preventive and treatment services (NewFields 2015). Central Kenai Peninsula Hospital and the Dena'ina Health Clinic serve the KPB. There is a lack of medical services for Beluga, Susitna, Skwentna, and Red Devil (NewFields 2015). The KPB and MSB areas are designated as medically underserved areas (MUAs) and the KPB area is also designated as a Health Professional Shortage Area (HPSA) (Section 3.22.3.6.8).

As noted in Section 2.3.2.1.11, on-site mine rescue and medical emergencies would be handled by a Mine Rescue Team. The team would include advanced first aid and emergency medical technician trained personnel. Medical evacuation would be available by fixed-wing aircraft or helicopter to fly injured workers to medical facilities. All industrial camps would also include First-Aid Units. The workforce employed at transportation facilities located near the mine site (such as the air strip and mine access road) would have access to medical services that would be available at the base camps. Workforce employed at other transportation facilities may obtain routine healthcare from the primary healthcare facility in Bethel and/or Dutch Harbor.

For all project phases, the health effect is anticipated to be medium (minor health injury). The intensity of the effect would be medium (residents living in the local communities would be able to easily adapt to the impact). The residents that routinely use the small clinics, such as those in the Kuskokwim River communities that are in close proximity to the mine site, could potentially be affected; therefore, the geographic extent of the impact would be medium with a limited number of households potentially affected. The duration of this impact would be high for the construction phase (3-4 years) and very high for the operations and maintenance (27 years) and closure, reclamation, and monitoring (>50 years) phases. Given that Donlin Gold would provide base camps equipped with on-site medical facilities for routine use by the workforce, it is unlikely (10-33 percent) that employees would routinely use off-site community healthcare resources. Therefore, a noticeable effect on access to routine healthcare services is not expected for residents living in the EIS Analysis Area, including the communities near the proposed mine site. The potential impact of decreased access to routine healthcare in the EIS Analysis Area would be low for all components and project phases.

Access to Healthcare due to Large Scale Emergency Situations and Overwhelming Local and Regional Healthcare Capacities

There is the potential to impact access to healthcare services and overwhelm local and regional capacities due to emergency situations that could occur during implementation of the proposed project. While much of the region is classified as medically underserved or has a shortage of health care professionals, the more urbanized communities such as Bethel, the MSB, and KPB, are serviced by a more extensive network of healthcare facilities including the YKDRH in Bethel, Fairbanks Memorial Hospital, McGrath Health Center, Central Kenai Peninsula Hospital, and the Dena'ina Health Clinic.

There is only one primary hospital (in Bethel) available for residents near the mine site that can handle emergency situations. Due to the remote region and terrain, air travel is the primary mode of large distance transportation, especially for medical issues. The industrial facility medical resources may not have the qualified or appropriate staff or equipment to handle life-threating health conditions or multiple injured personnel in an emergency situation. Also, availability and response time for air flight resources to provide travel to Bethel or Anchorage could be a limiting factor for quick access to healthcare if multiple individuals require emergency care.

For all project phases, the health effect would be high (moderate injury that may require intervention). The intensity of this impact would be medium because those potentially affected are estimated to be able to adapt to the impact and maintain pre-impact levels of health. The geographic extent of this impact would be high because the potentially affected communities in the region could be affected. The duration of this impact would be high for the construction phase (3-4 years) and very high for the operations and maintenance (27 years) and closure, reclamation, and monitoring (>50 years) phases. This impact is considered unlikely (10-33 percent) to occur due to industrial safety protocols that would be employed.

Alternative 2, HEC 8 Impact Summary: Health Services Infrastructure and Capacity

Under routine conditions, decreased access to healthcare services would be low. Under emergency situations, the summary impact is considered high with potential to overwhelm health care capacities. Alternative 2 could have a medium impact on regional healthcare capacities under emergency situations. The emergency situations are generally considered to be events with low probability of occurrence.

Table 3.22-25: Summary of HEC 8 Impacts: Health Services Infrastructure and Capacity

Potential Impact	Project Component	Project Phase	Negative/ Positive	Health Effect	Magnitude/ Intensity	Duration	Geographic Extent	Severity Ranking	Likelihood Rating	Impact Rating	Impact Level
Access to routine healthcare	All components: Mine Site, Transportation Facilities, Natural Gas Pipeline	Construction	–	Medium (1)	Medium (1)	High (2)	Medium (1), limited number of households	**5**	10-33%	*	**Low**
		Operations and Maintenance		Medium (1)	Medium (1)	Very high (3)	Medium (1), limited number of households	**6**	10-33%	*	**Low**
		Closure, Reclamation, and Monitoring		Medium (1)	Medium (1)	Very high (3)	Medium (1), limited number of households	**6**	10-33%	*	**Low**
Access to healthcare due to emergency situations and overwhelming local and regional healthcare capacities	All components: Mine Site, Transportation Facilities, Natural Gas Pipeline	Construction	–	High (2)	Medium (1)	High (2)	High (2)	**7**	10-33%	**	**Medium**
		Operations and Maintenance		High (2)	Medium (1)	Very high (3)	High (2)	**8**	10-33%	**	**Medium**
		Closure, Reclamation, and Monitoring		High (2)	Medium (1)	Very high (3)	High (2)	**8**	10-33%	**	**Medium**

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3.22.4.2.9 CLIMATE CHANGE

The proposed project would contribute to climate change as discussed in Section 3.8, Air Quality, through production of greenhouse gasses. The level of greenhouse gas emissions generated by implementation of Alternative 2 is not likely to create climate change effects to human health. If current climate change trends persist, impacts to human health and use would likely be similar to those discussed under Affected Environment (3.22.3.7).

3.22.4.2.10 SUMMARY OF IMPACTS FOR ALTERNATIVE 2

Overall, direct and indirect effects of Alternative 2 on human health would be medium, considering the impact ratings for all HECs (Table 3.22-26). Human health impacts resulting from Alternative 2 would be unique in context because they would affect primarily low income and minority communities, as discussed in Section 3.19, Environmental Justice.

Project-related economic benefits are expected to result in medium benefits to many aspects of human health including increased affordability and access to routine and emergency healthcare for acute and chronic conditions, improved food security and increased access to subsistence resources. Negative health consequences related to potential accidents and injuries, exposure to hazardous constituents, and infectious diseases are expected to be low to medium, and subject to control and mitigation based on the proposed project plans.

The impacts would generally be considered low to medium in magnitude or intensity, except for changes in accidents and injuries and non-communicable and chronic diseases where the intensity of the impact would be high. The duration of the impacts would generally be very high, except for infectious diseases and access to routine healthcare services where the duration of the impact would be high (changes in health indicators would not extend beyond 6 years and would likely return to baseline levels). The majority of impacts to human health would be low to medium in geographic extent, with the exception of non-communicable and chronic diseases and emergency situations overwhelming local and regional healthcare capacities. As noted in the discussion of emergency situations, these are considered to be low probability events.

Table 3.22-26: Alternative 2 Impact Levels by HEC

Health Effects Categories	Summary Impact Level	Adverse or Beneficial Rating
HEC 1: Social Determinants of Health		
Household incomes, employment, and education attainment	Medium	+
Psychosocial stress	Medium	+/-
Substance abuse (including drug and alcohol)	Medium	+/-
Family stress and instability	Medium	+/-
HEC 2: Accidents and Injuries		
Unintentional accidents and injuries morbidity and mortality rates due to air transportation	Medium	-
Unintentional accidents and injuries morbidity and mortality rates due to surface transportation	Medium	-

Table 3.22-26: Alternative 2 Impact Levels by HEC

Health Effects Categories	Summary Impact Level	Adverse or Beneficial Rating
Unintentional accidents and injuries morbidity and mortality rates due to water transportation	Medium	-
Intentional injury: poisoning/drug or alcohol overdose	Medium	-
Intentional injury: suicide rate	Medium	-
HEC 3: Exposure to Potentially Hazardous Materials		
Mercury impacts to air quality	Low	-
Surface water impacts	Low	-
Groundwater impacts	Low	-
Air quality impacts due to PM and VOCs	Low	-
Bioaccumulated chemicals in fish	Low	-
Bioaccumulated chemicals in waterfowl and wildlife	Low	-
HEC 4: Food, Nutrition, and Subsistence Activity		
Region food costs (expressed as a percent of median household income)	Medium – High	+
Diet composition and food security	Medium – High	+
Access to and quantity of subsistence resources	Low	-
HEC 5: Infectious Disease		
Rates of STI such as gonorrhea, chlamydia, and HIV	Medium	-
Rates of respiratory diseases such as influenza and pneumonia	Medium	-
Foodborne illness and zoonotic disease	Low	-
HEC 6: Water and Sanitation		
Access to water and sanitation facilities	Low	-
HEC 7: Non-communicable and Chronic Disease		
Cancer, respiratory, and cardiovascular morbidity and mortality rates	Medium	-
HEC 8: Health Services Infrastructure and Capacity		
Access to routine healthcare	Low	-
Access to healthcare due to large scale emergency situations	Medium	-
Alternative 2 Summary		
Summary Conclusion	Medium	+/-

Notes:

1 The summary impact rating accounts for impact reducing design features proposed by Donlin Gold and Standard Permit Conditions and BMPs that would be required. It does not account for additional mitigation measures the corps is considering.
The ratings presented in this table are based on the ADHSS (2011, 2015) methodology. The terms differ from terms used in other sections of the EIS. See Section 3.22.3 and Tables 3.22-15 and 3.22-16 for overview of methodology.

These effects determinations take into account impact reducing design features (Table 5.2-1 in Chapter 5, Impact Avoidance, Minimization, and Mitigation) proposed by Donlin Gold and also the Standard Permit Conditions and BMPs (Section 5.3 in Chapter 5, Impact Avoidance, Minimization, and Mitigation) that would be implemented. Several examples of these are presented below.

Design features most important for reducing impacts to human health include:

- Donlin Gold would develop and implement a drug and alcohol abuse prevention program for employees;
- Donlin Gold would develop an Operations and Maintenance Plan/Manual; Health, Safety, and Environment Plan (including a Safety Plan/Program), Pipeline Surveillance and Monitoring Plan, and other plans that would outline safety measures that would be implemented during operations;
- Monitor physical (water quality) and biological (fish, wetlands) resources during all project phases (construction, operations, reclamation, and post-closure) in Crooked Creek; and
- At the TSF dry beach the project design includes installing silt fences, removing snow from active placement areas only, and using polymer dust suppressant.

Standard Permit Conditions and BMPs most important for reducing impacts to human health include:

- Developing spill prevention and response type plans as required by federal and state requirements. The plan(s) will prescribe effective processes and procedures to prevent the spill of fuel or hazardous substances and include procedures to respond to accidental releases; and
- Developing an Erosion and Sediment Control Plan and Storm Water Pollution Prevention Plans prior to the commencement of ground disturbance activities.

3.22.4.2.11 ADDITIONAL MITIGATION AND MONITORING FOR ALTERNATIVE 2

The Corps is considering additional monitoring (Table 5.7-1 in Chapter 5, Impact Avoidance, Minimization, and Mitigation) to monitor the effects presented above. Additional monitoring measures include:

- Fish tissue monitoring should include development of site-specific bioaccumulation factors (BAFs) for methylmercury evaluation. Contingency measures (adaptive management) should be developed and defined if impacts occur beyond what are expected.
- Monitor socioeconomic conditions (population, demographics, employment, income, education, and health indicators) in Y-K villages using existing/annually updated state and federal statistics.

If these monitoring measures were adopted and required, the effects to human health could be somewhat reduced. The summary impact ratings would remain the same for all project components.

3.22.4.3 ALTERNATIVE 3A – REDUCED DIESEL BARGING: LNG-POWERED HAUL TRUCKS

Alternative 3A would use liquefied natural gas (LNG) instead of diesel to power the large trucks that would move waste rock and ore from the open pits. Alternative 3A would result in a 33 percent reduction in total river barge traffic due to reduced barging of diesel fuel. The primary differences between this alternative and Alternative 2 are the addition of the LNG plant and storage tanks near the processing plant, reduced consumption of diesel, reduced barge trips, reduced on-site diesel storage, and increased natural gas consumption.

Overall, the positive and negative health consequences related to Alternative 3A would be similar to Alternative 2 for most of the HECs for the all components. The HECs for which consequences may be different from Alternative 2 are as follows:

3.22.4.3.1 HEC 2: MORTALITY AND MORBIDITY ASSOCIATED WITH ACCIDENTS RELATED TO WATER TRANSPORT

Under Alternative 3A, the increase in barge traffic for both ocean and river barges under Alternative 3A (relative to baseline), though less than Alternative 2, would still result in noticeable disturbance and limited displacement of other uses at the Bethel port facilities and in narrow reaches of the river. Therefore, the primary difference in impacts relative to Alternative 2 would be that the nature of the health impacts (mortality and morbidity due to accidents and injuries) would be similar and the summary impact rating would remain medium.

3.22.4.3.2 HEC 3: EXPOSURE TO HAZARDOUS CONSTITUENTS

This alternative would decrease emission loads and thereby reducing the overall quantity of hazardous contaminants in the air at the mine site and along the transportation corridors during the operations phase. The health effect improvement would be localized and limited to the construction and operations phases. Since diesel engines would still be used at other project components and phases, there would be no change to the list of hazardous contaminants, exposure pathways or receptors. The potential health impact from exposure to media contaminated by a spill or leak of diesel fuel would be reduced.

Overall, the consequences related to hazardous constituents for this alternative are related to the transportation component. There may be less exposure to hazardous constituents in air and in surface water in the Kuskokwim River but constituents in air would be less than the applicable air quality standards and permitting thresholds for both Alternative 2 and 3A. Impacts to water quality may be seen as lower concentrations of chemicals in water and aquatic biota, in comparison to Alternative 2, thus resulting in lower exposures. Impacts to human health related to air quality, surface water quality, and consumption of fish from the Kuskokwim River, as associated with Alternative 3A, are considered to be low; the same as for Alternative 2.

3.22.4.3.3 HEC 4: ACCESS TO AND QUANTITY OF SUBSISTENCE RESOURCES

The reduction in river barge traffic would reduce impacts to fish and subsistence fishing in narrow reaches of the river to low intensity, relative to Alternative 2. Effects on subsistence uses from changes in subsistence resources and access to subsistence resources in the vicinity of the mine site and along the natural gas pipeline route would be the same as in Alternative 2. The summary impact of Alternative 3A would be the same as Alternative 2, low.

3.22.4.3.4 SUMMARY FOR ALTERNATIVE 3A

Overall, the health consequences for Alternative 3A are similar to Alternative 2. The health consequences related to Alternative 3A that were considered to be different from Alternative 2 were reduced rates of accidents and injuries related to water transport; reduced exposures to hazardous constituents in air, water and aquatic biota; and greater access to and quantity of subsistence resources. While the reduction in these consequences relative to Alternative 2 would be considered beneficial to health, these health effects are rated medium, the same as Alternative 2. Impacts associated with climate change would also be the same as discussed for Alternative 2. The effects determinations take into account applicable impact reducing design features and monitoring, as discussed in Alternative 2.

3.22.4.4 ALTERNATIVE 3B – REDUCED DIESEL BARGING: DIESEL PIPELINE

Under Alternative 3B, an 18-inch diameter diesel pipeline would be constructed from Cook Inlet to the mine site to eliminate diesel barging on the Kuskokwim River. Alternative 3B would eliminate the 58 fuel barge tow round trips per year required under Alternative 2. Total annual barging would be reduced by 48 percent, as cargo barging would still occur on the Kuskokwim River, as proposed in Alternative 2. The natural gas pipeline proposed in Alternative 2 would not be constructed. The diesel pipeline would be located in the same corridor proposed for the natural gas pipeline under Alternative 2, with an additional 18-mile segment from the proposed terminus of the natural gas pipeline, south to Tyonek. This additional segment would cross the Beluga River.

This alternative would require either construction of a new dock facility in Tyonek or expansion of the existing Tyonek North Foreland Barge Facility. A new tanker berth system would be needed at Tyonek to accommodate the tide, ice, and seismic conditions and provide adequate depth for continuous 24-hour operation. A barge landing at Tyonek sufficient for most tidal stages would be required to support the construction and operation of the facilities. Tanks sufficient for storing one month's fuel consumption, approximately 10-million gallons, would be installed at each end of the pipeline. There would be no change in the location of the mine site under Alternative 3B; however, diesel fuel would be used instead of natural gas.

The positive and negative health consequences related to Alternative 3B would be similar to Alternative 2 for most of the Health Effects Categories. The HECs for which consequences may be different from Alternative 2 are as follows:

3.22.4.4.1 HEC 2: MORTALITY AND MORBIDITY ASSOCIATED WITH ACCIDENTS RELATED TO WATER TRANSPORTATION

The potential human health impact would be similar to Alternative 2, noting a reduction potential reduction in accidents and injuries with a reduction in barge traffic for the operations phase. Other impact ratings would remain the same. The summary impact would remain medium.

3.22.4.4.2 HEC 3: EXPOSURE TO HAZARDOUS CONSTITUENTS

Under normal operations, this alternative would not change the hazardous contaminants, exposure pathways, or receptors. Relative to Alternative 2, this alternative would have less negative impacts on air quality, water quality, and biota in the Kuskokwim River due to the reduction in barge traffic. The summary impact rating is low; the same as for Alternative 2.

3.22.4.4.3 HEC 4: HEALTH EFFECTS ASSOCIATED WITH ACCESS TO AND QUANTITY OF SUBSISTENCE RESOURCES

Negative health impacts related to subsistence activity would be reduced under Alternative 3B, with a decrease in river barge traffic. Decreased disturbance in the Kuskokwim River could accommodate greater access to and quantity of subsistence resources. The diesel tanker traffic to the modified Tyonek North Forelands Facility would increase the potential for disturbance or collisions, but the occurrence of marine mammals in that area is low (Section 3.12.4.2.4, Wildlife). As a result, low level impacts are estimated to marine mammal subsistence hunting by Tyonek residents (Section 3.21.6.5, Subsistence). The summary impact rating is low for Alternative 3B, which is the same as Alternative 2.

3.22.4.4.4 SUMMARY FOR ALTERNATIVE 3B

The human health impacts for Alternative 3B are similar to Alternative 2. The health consequences related to Alternative 3B that were considered to be different from Alternative 2 were reduced rates of accidents and injuries related to water transport; reduced exposures to hazardous constituents in air, water and aquatic biota; and greater access to and quantity of subsistence resources. The reduction in these consequences relative to Alternative 2 would be considered beneficial to health. When the intensity, duration, and extent of the range of health effects categories is considered over all phases of the project, the summary impact rating for health for Alternative 3B is rated as medium, the same as for Alternative 2. Impacts associated with climate change would also be the same as discussed for Alternative 2. The effects determinations take into account applicable impact-reducing design features and monitoring, as discussed in Alternative 2.

3.22.4.5 ALTERNATIVE 4 – BIRCH TREE CROSSING (BTC) PORT

Alternative 4 would move the upriver port site from Angyaruaq (Jungjuk) (under Alternative 2) to Birch Tree Crossing, located about 124 river miles upriver from Bethel. This would reduce the barge distance for freight and diesel out of Bethel bound for the mine site by 75 miles, or 38 percent. The same volume of cargo and diesel fuel would be transported by barge as in Alternative 2. The BTC mine access road would be 76 miles long, versus 30 miles for the mine access road from Angyaruaq (Jungjuk) Port, an increase of 46 miles. The shorter barge distance would eliminate impacts from barging to communities where the Kuskokwim River narrows upriver of the BTC, including Aniak, Chuathbaluk, and Napaimute.

HECs for which consequences may be different from Alternative 2 are as follows:

3.22.4.5.1 HEC 2: MORTALITY AND MORBIDITY ASSOCIATED WITH ACCIDENTS RELATED TO WATER TRANSPORT

The reduced barging distance would result in shorter round trip barge transportation times from Bethel to the BTC Port; however, the same number of tows would be required as Alternative 2. Alternative 4 would have fewer days of traffic than Alternative 2, but would remain a large increase in traffic relative to the baseline conditions. Since the number of barge trips would be the same as under Alternative 2, the potential for accidents and injuries is expected to remain the same, although it may be limited to a smaller section of the river.

The human health impacts to surface transportation would be similar to Alternative 2 since the road would not be accessible from communities in the vicinity or open to the public. The potential health impact for accidents and injury would be similar to Alternative 2, except for small reductions in the geographic extent of potential mortality and morbidity related to vessel transport.

3.22.4.5.2 HEC 3: EXPOSURE TO HAZARDOUS CONSTITUENTS

Alternative 4 would not change the hazardous contaminants, exposure pathways, or receptors. The potential health impact from exposure to media contaminated by a spill or leak of diesel fuel in the river would be reduced in geographic extent. Impacts to air quality may increase in the vicinity of the additional section of surface roadway in a localized manner; however, exposures to the roadway would be limited due to access restrictions. For exposure to hazardous constituents, impacts would be similar to Alternative 2.

3.22.4.5.3 HEC 4: HEALTH EFFECTS ASSOCIATED WITH ACCESS TO AND QUANTITY OF SUBSISTENCE RESOURCES

As noted in Subsistence Section 3.21.6.6, subsistence resources impacts would be reduced for subsistence fisheries under Alternative 4 since a smaller portion of the Kuskokwim River would have barge traffic, relative to Alternative 2. However, a larger area of terrestrial subsistence resources, such as moose, may be affected due to the longer stretch of roadway during the construction and operations phases. Impacts to human health would be similar to Alternative 2, except for lower intensity of effects to subsistence fishery resources and greater impact from the mine access road to habitat for terrestrial subsistence resources.

3.22.4.5.4 SUMMARY FOR ALTERNATIVE 4

The summary impact rating for human health impacts under Alternative 4 would be medium, the same as those under Alternative 2, noting a reduction in the potential for vessel accidents and injuries, an increase in potential surface transport accidents and injuries, a reduction in potential subsistence fisheries impacts, and a potential increase in the displacement of wildlife used by subsistence hunters. Impacts associated with climate change would also be the same as discussed for Alternative 2. The effects determinations take into account applicable impact reducing design features and monitoring, as discussed in Alternative 2.

3.22.4.6 ALTERNATIVE 5A – DRY STACK TAILINGS

Alternative 5A would use a “dry stack” process to reduce the potential of tailings water leaving the tailings storage facility. Direct and indirect impacts for the transportation facilities and pipeline components would be the same as under Alternative 2. For the mine site, the probability for exposure to potentially hazardous materials (HEC 3) would be reduced, but the summary impact rating would be medium, the same as Alternative 2.

The direct and indirect human health impacts of Alternative 5A would be similar to those under Alternative 2 and the summary impact conclusion is the same. Impacts associated with climate change would be the same as discussed for Alternative 2. The effects determinations take into account applicable impact reducing design features and monitoring, as discussed in Alternative 2.

3.22.4.7 ALTERNATIVE 6A – MODIFIED NATURAL GAS PIPELINE ALIGNMENT: DALZELL GORGE ROUTE

Under Alternative 6A, the pipeline route would be west of the alignment described under Alternative 2 between MP 106.5 and 152.7, and would traverse the Dalzell Gorge. The mine site and transportation facilities would remain the same as described under Alternative 2 and effects would be very similar to Alternative 2.

Alternative 6A would require larger workforce and higher expenditures due to more horizontal directional drilling than Alternative 2, which could increase the socioeconomic benefits to communities within the EIS Analysis Area. Under normal operations, this alternative would not change the hazardous contaminants, exposure pathways or receptors. This area would be outside of the subsistence use area of Skwentna, the closest community to the alignment variation, so there would be no change to the subsistence impacts identified under Alternative 2. Thus, the summary impact rating would be medium, the same as Alternative 2. Impacts associated with climate change would be the same as discussed for Alternative 2. The effects determinations take into account applicable impact reducing design features and monitoring, as discussed in Alternative 2.

3.22.4.8 IMPACT COMPARISON – ALL ALTERNATIVES

A comparison of the impacts to human health by alternative is presented in Table 3.22-27.

Table 3.22-27: Comparison of Impacts by Alternative*

Impact-causing Project Component	Alt. 2 – Proposed Action	Alt. 3A – LNG-Powered Haul Trucks	Alt. 3B – Diesel Pipeline	Alt. 4 – BTC Port	Alt. 5A – Dry Stack Tailings	Alt. 6A – Dalzell Gorge Route
HEC 1: Social Determinants of Health:	Increases in household incomes, employment rates, and education attainment could result in an improvement to the overall health and well-being of residents. The potential impacts of psychosocial stressors, such as high unemployment, low income, low education attainment, outward population migration, and rural isolation could be lessened by the potential for increased economic opportunities. There is also the potential for increases in psychosocial stress, related to fear of changes in lifestyle and cultural practices, impact to natural resources (e.g., soil, air, groundwater, and surface water), and food security and quality. Increases or decreases in substance abuse (drug and alcohol consumption) rates could occur. The summary impact level (beneficial and adverse) is considered medium.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
HEC 2: Accidents and Injuries:	The summary impact of accidents and injuries was rated medium. The accidents and injuries discussed in this section are generally considered to be events with low probability of occurrence, but high consequence if they did occur.	Decreased potential for water transport accidents.	Decreased potential for water transport accidents	Potential for accidents and injuries decreased for water transport increased for surface transport.	Same as Alternative 2.	Same as Alternative 2.

Table 3.22-27: Comparison of Impacts by Alternative*

Impact-causing Project Component	Alt. 2 – Proposed Action	Alt. 3A – LNG-Powered Haul Trucks	Alt. 3B – Diesel Pipeline	Alt. 4 – BTC Port	Alt. 5A – Dry Stack Tailings	Alt. 6A – Dalzell Gorge Route
HEC 3: Exposure to Potentially Hazardous Materials:	Effects to human health related to groundwater quality would occur only if project-related contamination were to migrate out to where groundwater usage may be occurring. The principal mechanisms responsible for effects to groundwater quality at the mine site would be inputs of seepage from the WRF and TSF to shallow groundwater resources underneath and immediately adjacent to the WRF, and the discharge of water from the pit to the surrounding deep bedrock groundwater. Groundwater that could potentially be contaminated by inputs of WRF seepage would flow towards the pit, and the spatial extent of the impacts would be limited because the contaminated groundwater would be intercepted by the pit and the pit dewatering system. Similarly, seepage and leakage from the TSF would be captured, contained, and treated, and impacts to groundwater would be minimized. Fugitive dust generated during mine site construction (pre-production) and operations could potentially result in elevated concentrations of metals in soils surrounding the mine site over time through dust deposition. Given the low predicted overall increase in mercury content in soil and sediment and lack of large change anticipated for methylmercury production rates, potential changes in mercury concentrations in plants, fish, and wildlife as result of the proposed project were predicted to be small. The summary impact level for exposure to potentially hazardous materials is low for all project components and all project phases.	Decreased emission loads, reducing the overall quantity of hazardous contaminants in the air, and surface water.	Decreased impacts on air quality, water quality and biota in the Kuskokwim River, due to the reduction in barge traffic.	Impacts to air quality may increase in the vicinity of the additional section of surface roadway, but would remain low.	Same as Alternative 2.	Same as Alternative 2.

Table 3.22-27: Comparison of Impacts by Alternative*

Impact-causing Project Component	Alt. 2 – Proposed Action	Alt. 3A – LNG-Powered Haul Trucks	Alt. 3B – Diesel Pipeline	Alt. 4 – BTC Port	Alt. 5A – Dry Stack Tailings	Alt. 6A – Dalzell Gorge Route
HEC 4: Food, Nutrition, and Subsistence Activity:	Medium to high beneficial impacts would result from increases in economic opportunities, increase in the median household incomes, decreases in regional food costs, and an increase in food security. Low levels of adverse impacts could result from changes in access to and/or quantity of subsistence resources in the region could occur as a result of changes in employment (population outward migration), the fly-in, fly-out work rotations of the workforce, and overlap of subsistence resources and uses in the vicinity of project components.	Reduced impacts to fish and subsistence fishing due to reduced barging.	Reduced impacts to fish and subsistence fishing due to reduced barging.	Impacts to subsistence fisheries reduced, increased potential for displacement of terrestrial wildlife.	Same as Alternative 2.	Same as Alternative 2.
HEC 5: Infectious Diseases:	The adverse impact of increased rates of infectious diseases is rated low to medium. Increases in infectious disease rates could occur due to employment of workers from outside the region and/or the rotation of the workforce. Health impacts are considered to be low.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
HEC 6: Water and Sanitation:	Impacts to the availability and quality of water and sanitation services of the potentially affected communities are considered unlikely. Health impacts are considered to be low.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
HEC 7: Non-communicable and chronic diseases:	Increased cancer, respiratory, and cardiovascular morbidity and mortality rates due to increased exposure to hazardous air pollutants is considered unlikely. Health impacts are considered to be low to medium.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
HEC 8: Health Services Infrastructure and Capacity:	Under routine conditions, decreased access to healthcare services would be low. Under emergency situations, the summary impact is considered medium, with potential to overwhelm health care capacities. The emergency situations discussed in this section are generally considered to be events with low probability of occurrence.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.

Notes:

* The No Action Alternative would have low direct or indirect effects to human health, largely returning to pre-impact levels.

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